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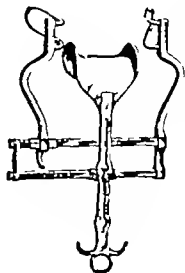
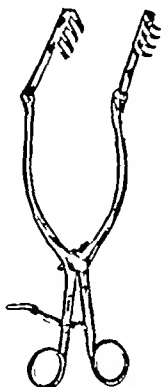
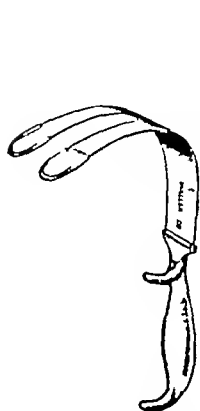
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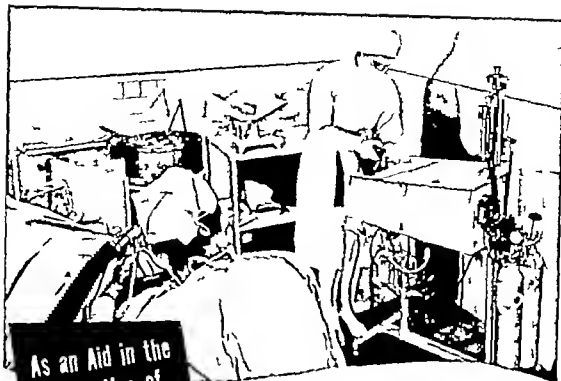
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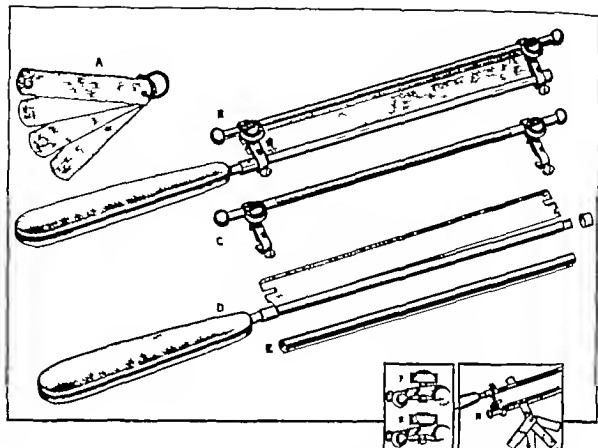
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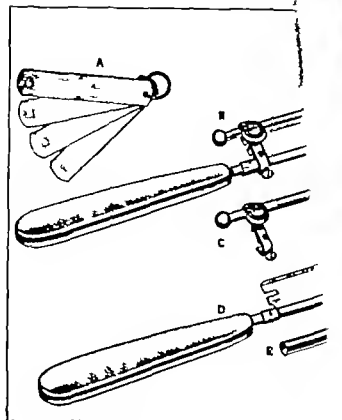
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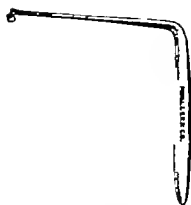
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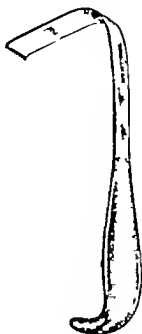
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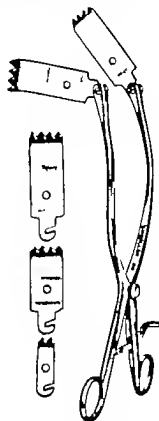
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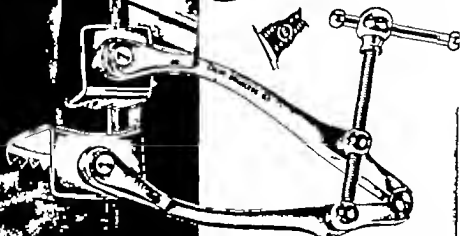
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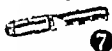
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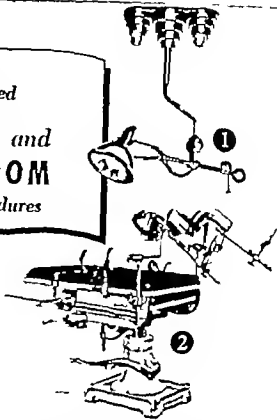
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TRAUMATIC ANEURYSM

The Matas Operation—Fifty-Seven Years After

DANIEL C. ELKIN M.D., F.A.C.S. Colonel M.C. A.U.S.

White Sulphur Springs, West Virginia

THE report of the first patient treated by endoaneurysmorrhaphy was made by Dr. Rudolph Matas in the *Philadelphia Medical News* October 27, 1888. In the 57 years which have intervened since that memorable publication no alterations in the technique of the procedure other than minor niceties have been made. Few operations have stood this test of time and none has had a more profound effect upon the surgery of blood vessels.

Dr. Matas has recorded the story of his first operation as follows:

On April 6, 1888, I operated upon a young male Negro for a very large traumatic (multiple gunshot) aneurysm of the brachial artery extending from the armpit to the elbow which opened my eyes to the possibilities of an entirely new method of conservative treatment which was to revolutionize my previous notions of aneurysmal surgery. In this case, the successive ligation of the main artery on the proximal and distal poles of the aneurysm had been followed by relapse and it seemed to me, then, that I had no other alternative but to extirpate the sac. When I exposed the sac and emptied its contents the failure of the ligations to control the circulation was easily explained by the appearance in the bottom of the sac of three large orifices corresponding to the collateral branches which opened into the sac in the segment of the artery included between the ligatures (Fig. 1). It was evident that it was these collateral orifices that fed the sac despite the ligatures that had been placed at each one of its poles.

From the Vascular Surgery Center, Ashford General Hospital, White Sulphur Springs, West Virginia.

I at first intended to secure these collaterals by excising the sac, but the branches of the brachial plexus of nerves were so densely incorporated in its walls that I could not have dissected them out and detached them without serious damage thereby paralyzing the arm. It occurred to me then that the easiest way out of this awkward dilemma was to seal the orifices of all the bleeding collaterals by suturing them as we would an intestinal wound leaving the sac attached and undisturbed in the wound. This procedure was at once put into effect and the hemostasis was so perfect and satisfactory that it seemed to me strange that no one should have thought of so simple an expedient before.

Prior to the introduction of this procedure aneurysms were treated by a variety of methods most of them unsuccessful. Compression by various methods (digital bandaging, instrumental) and the introduction of sclerosing and coagulating agents were employed. Older operative methods included that of Antyllus (fourth century A.D.) which consisted of ligation of the vessel above and below the sac, the evacuation of its contents and the application of an astringent or of packing. Aclis's operation (1710) consisted of ligation of the proximal artery close to the sac. One half century later John Hunter tied the femoral artery in the canal which bears his name for aneurysm of the popliteal artery. It was Hunter's idea to bring clotting and eventual cure of the aneurysm and at the same time preserve a collateral circulation. In this

he was highly successful except for the frequent recurrences which took place through the circulation which he was so anxious to preserve. As has been pointed out by Homan since Hunter's time the preservation of the collateral circulation has become an essential part of every curative procedure. It is upon this theory that the Matas endoaneurysmorrhaphy is based. Later Braxdor and Wardrop independently ligated the artery or one of its principal branches on the distal side of the sac in an attempt to arrest the circulation through it. These procedures were at best a makeshift and were usually performed only when the position of the aneurysm prevented other forms of treatment. In many instances amputations were performed for the relief of pain and in order to prevent an almost certain eventual fatal hemorrhage. All of these methods with the exception of the Matas procedure were frequently followed by infection, hemorrhage, gangrene or failure to cure the condition (Fig 2).

The incidence of multiple injuries in the present war as a result of high explosive shells, grenades and antipersonnel mines has led to the production of a larger number of vascular injuries than in any other conflict. While small fragments are more apt to cause arteriovenous fistulas many produce false aneurysms as well and to many of these the principle of intrasaccular closure is applicable. In cases in which the aneurysm is large and in which its dissection would unquestionably result in damage to surrounding structures such as muscles, nerves and other blood vessels, the Matas operation is certainly the procedure of choice. It is difficult to employ in a small aneurysm or where the lesion is accompanied by nerve damage. Here the passage of sutures may damage neural structures and it is better to carry out neurolysis or nerve suture as a single procedure with excision of the aneurysm. However, the principle of intrasaccular suture may well be applied to those instances of arteriovenous aneurysm in which a large venous sac is present as in Case 8 (Fig 3).

The endoaneurysmorrhaphy of Matas is simple in conception and if the principles of

its application are borne in mind it is extremely easy to carry out. Wherever possible a tourniquet should be applied before the sac is opened but if this is precluded by the position of the aneurysm temporary occlusion of the proximal vessel as shown in Cases 1, 2 and 3 is of aid in performing the operation in a less bloody field. As soon as the sac is opened and its clot is evacuated search should be made for the openings in the artery into the aneurysm. If not readily found, temporary loosening of the tourniquet will disclose their position. Usually one or two figure-of-eight sutures of medium silk are sufficient to close the openings but if any bleeding occurs following removal of the tourniquet these can be re-enforced by the placing of other sutures (Fig 4). Actual obliteration of the sac by sutures is difficult because of its friable nature and any suture is apt to cut through. When bleeding is controlled and the clot including the lamellations, is removed the sac will readily collapse and its walls coalesce with the application of a snug elastic bandage. In some instances, the proximal and distal vessels can be dissected from surrounding structures within the sac and individually ligated (Fig 4). When this is done there is less danger of injuring concomitant veins or neural structures, and the vessels are ligated with more confidence.

One hundred and six instances of false aneurysm have been treated by operation at this hospital in the past 30 months. In 61 the Matas procedure has been employed and in 45 some other type of operation, usually complete excision of a small sac, has been the method used. The location of the lesions treated by intrasaccular suture is shown in Table I.

Results. There have been no deaths in this series, no recurrence and no instance of gangrene. Sympathetic interruption has not been practiced either before or after operation but it is admittedly a valuable adjunct in increasing blood flow in the presence of ischemia. Careful tests for evaluating collateral circulation were routinely carried out before the operation and when it appeared that the circulation was impaired compression of the vessel proximal to the aneurysm was carried out for some

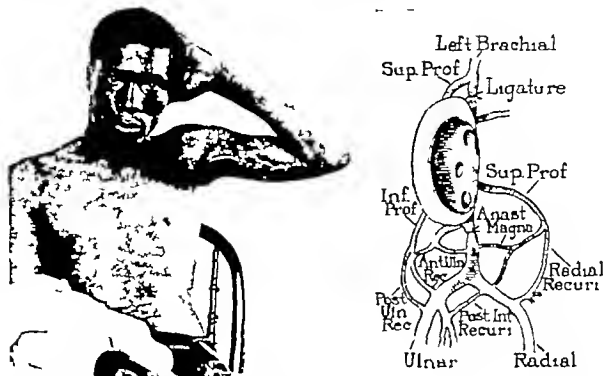


Fig 1 The original photograph and drawing shown in report of Dr. Matas, *Philadelphia Medical Voez*, October 27 1893.

time before operation. In general it was believed that if a period of 3 months had elapsed between injury and operation adequate collateral flow had been established. This feeling has been justified in view of the results.

ILLUSTRATIVE CASES

CASE 1: False aneurysm left gluteal artery due to high explosive shell fragment wound. Incurred February 27 1945. Extraperitoneal temporary occlusion of common iliac artery. Endoaneurysmorrhaphy superior gluteal artery. June 8 1945. Recovery.

This 26 year old soldier received multiple wounds in the region of the left hip from high explosive shell fragments. Bleeding was not profuse. Because of abdominal pain and swelling in his hip region and the presence of an abdominal mass which could be palpated by rectum an operation was performed in England on April 12 1945 at which time the left internal iliac artery was ligated. There was some improvement in his symptoms but in the 30 days prior to admission to Ashford General hospital on June 3 there was increased swelling in the left hip and buttock with severe pain controlled only by morphine. On admission there was a large soft mass over the whole left hip region extending as far medially as the sacrum (Fig 5a). There was a small healed wound in the center of this massive swelling. Directly over the mass a systolic murmur could be heard and the mass pulsed synchronously with the heart beat.

On June 8 1945 operation was performed under continuous spinal anesthesia. The common iliac artery was exposed through an extraperitoneal incision and a ligature was passed around it which was not tied and the vessel was temporarily occluded with an artery clamp. A vertical incision was then made directly over the center of the aneurysm (Fig 5b) and clot measuring 700 cubic centimeters in volume was evacuated. With removal of the clot there was considerable bleeding which was found to come from two openings in the superior gluteal artery about 1.5 centimeters apart. Both openings were closed with two figure-of-eight sutures with complete control of the bleeding. The clamp previously placed on the common iliac artery was then removed which caused some bleeding from the muscles and skin which was easily controlled. Both wounds were then closed in layers with interrupted sutures of silk. His recovery was without event and the pain previously complained of rapidly disappeared.

CASE 2: False aneurysm right femoral artery due to high explosive shell fragment wound incurred July 5 1944. Endoaneurysmorrhaphy. August 13 1944. Recovery.

This 26 year old soldier was struck by high explosive shell fragments on July 5 1944. He received multiple wounds of both legs. While in an evacuation hospital, he had three hemorrhages from wounds of the left leg and on July 17 1944, one was so severe as to require ligation of the left posterior tibial artery and vein. Since the time of the original wounds he had noticed gradual enlargement of the right anterior thigh region which continued to in-

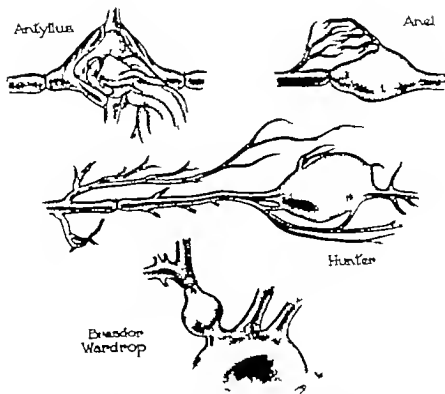


Fig. 2. Diagrammatic Illustration of the types of operation employed for the treatment of aneurysms prior to the introduction of endoaneurysmorrhaphy

crease in size until his transfer to Ashford General Hospital, August 13, 1944. At that time he was complaining of pain in the right thigh. On examination there were numerous small well healed wounds in the left leg. On the upper anterior surface of the right thigh there was a large mass 15 by 30 centimeters. The mass was pulsating and over it a harsh systolic murmur could be heard (Fig. 6a).

Since the mass was steadily increasing in size, an immediate operation was carried out. Through a small transverse incision just below Poupart's ligament, the common femoral artery was identified and temporarily occluded with an artery clamp. An incision 8 inches long was then made along the course of the femoral artery directly over the aneurysm (Fig. 6b). The sac was opened and approximately 1200 cubic centimeters of clot was evacuated. Two openings in the femoral artery were closed with figure-of-eight sutures. The vessel was at the bottom of the sac which was bound by Hunter's canal posteriorly and the sartorius muscle anteriorly (Fig. 6c). The clamp was released from the femoral artery and there was no further bleeding. The deep fascia and skin were closed with interrupted sutures of silk and a tight pressure bandage applied. His recovery was uneventful and the circulation in his foot and toes remained good.

CASE 3 False aneurysm, left superficial femoral artery and false aneurysm left profunda femora

artery upper third due to high explosive shell fragment wounds incurred August 29 1944. Endoaneurysmorrhaphy left femoral artery upper third. Endoaneurysmorrhaphy left profunda femora artery upper third October 13 1944. Recovery

On August 29, 1944 this 32 year old soldier was struck by two shell fragments, both of which entered the anterior surface of the left thigh. The wounds were debrided and closed. About 5 days after injury a swelling developed in the left anterior thigh region which was diagnosed as an aneurysm and he was evacuated to the United States. Shortly after reaching this country swelling began to increase gradually and he was admitted to Ashford General Hospital, October 11 1944. At that time, he was complaining of pain in the leg and thigh. There was a massive spherical swelling on the anterior surface of the left thigh, about 10 centimeters below Poupart's ligament (Fig. 7a). The mass pulsated with each heartbeat but there was no thrill. A distinct systolic bruit could be heard over it.

On October 13 1944 operation was performed under spinal anesthesia. A small transverse incision was made over the femoral artery just below Poupart's ligament and a temporary nonoccluding suture was passed around it. It was then occluded with a bulldog artery clamp. A longitudinal incision 6 inches long was made over the swelling, along the course of the femoral vessels (Fig. 7b).

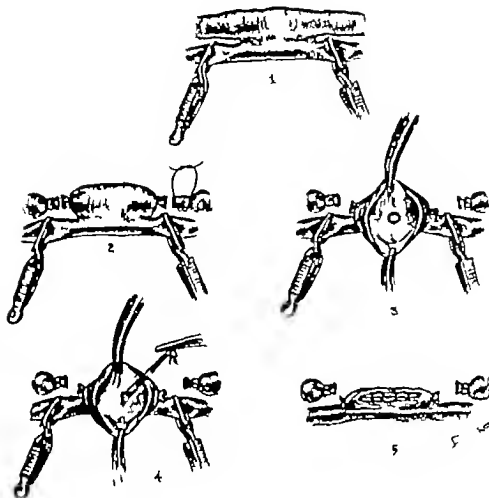


Fig. 3 Steps generally employed in the transvenous or transmuscular repair of an arteriovenous fistula with preservation of the artery

The sac was opened and a clot about 500 cubic centimeters was evacuated. There was brisk bleeding from an opening in the femoral artery which was easily stopped by pressure with the fingers and was closed with several interrupted sutures of silk. The vessel just proximal and distal to this opening was dissected free from surrounding structures and again ligated.

Following this the thigh still appeared tense and firm and, on this account, the fascia covering the adductor group of muscles was incised and another larger aneurysm disclosed. A clot of approximately 1000 cubic centimeters was evacuated and an opening was found in the profunda femoris artery. This was closed with 4 interrupted sutures of silk. The sac was limited posteriorly by the adductor magnus muscle and laterally by the femur (Fig. 7c). The deep fascia and skin were closed with interrupted sutures of silk, and a snug pressure bandage was applied. In spite of the ligation of the superficial femoral and profunda femoris arteries, circulation in his toes and foot was good at the end of the operation and remained so. The wound healed without difficulty.

CASE 4. False aneurysm right external iliac artery due to bullet wound incurred June 27 1944

Endoneurysmorrhaphy and proximal ligation of the external iliac artery September 16 1944

This officer received a through-and-through 30 caliber bullet wound of the abdomen June 27 1944. The bullet entered the right lower quadrant anteriorly and made its exit just to the right of the 5th lumbar vertebra. Shortly thereafter he was operated upon and several perforations of the small intestine were repaired. His recovery from this operation was prompt except for superficial wound infection which soon healed. He was admitted to Ashford General Hospital August 28, 1944 complaining of pain in the right groin and throbbing in the right lower abdomen.

On examination there was a well healed lower right paramedian scar extending from the umbilicus to Poupart's ligament. Immediately above Poupart's ligament and underlying the scar was a mass approximately 6 centimeters in diameter. The mass was pulsating with each heart beat, and a systolic bruit could be heard over it. There was no thrill. The right dorsalis pedis and posterior tibial pulses could be felt, but both were weak in comparison to the other side. Oscillometric readings were diminished on the right.

Operation was performed September 16 1944. The old scar which had been made for the closure of

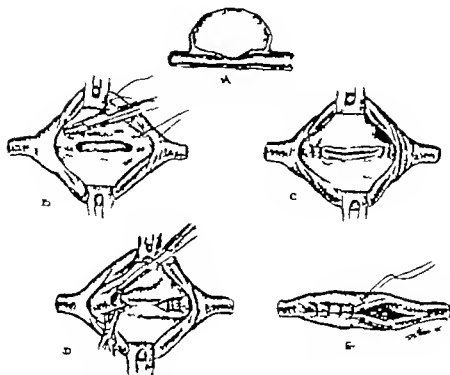


Fig. 4. Diagrammatic illustration of endoaneurysmorrhaphy. A, Cross section of artery with false sac. B, Sutures are placed to close the arterial openings within the sac. C, Sutures tied. D, Occasionally the vessel is isolated and ligated. E, Occasionally the sac is obliterated by further sutures.

intestinal perforation was excised. The peritoneum was dissected upward until the artery above the aneurysm could be reached. It was isolated and temporarily occluded with an artery clamp. The artery distal to the aneurysm was treated in a similar manner. The sac was opened and two arterial openings in it were closed with interrupted sutures of silk. On removal of the clamp there was still some bleeding from the proximal opening which could be controlled only by ligation of the artery proximal to the aneurysm. No attempt was made to

remove the sac (Fig. 8). The wound was closed in layers. Circulation in the foot and toes was good at the end of the operation and remained so. The patient's recovery was uneventful and he was returned to duty of a limited nature.

CASE 5. False aneurysm, right axillary artery, due to high explosive shell fragment wound incurred May 10, 1944. Endoaneurysmorrhaphy June 23, 1944. Recovery.

This soldier was wounded on May 1, 1944, by a small shell fragment entered his anterior chest just beneath the right clavicle and made its exit just below the scapula on the right side. Subsequently he developed a hemothorax which necessitated aspiration. At the time of his injury there was considerable bleeding from the wound in the anterior chest, which was controlled by pressure. Immediately following the wound he also noticed complete paralysis of the right upper extremity. About June 1, massage and active motion of the right shoulder was begun and shortly after this he noted the appearance of a swelling in the right axillary and subclavicular region. This swelling gradually increased in size until the time of his admission to Ashford General Hospital on June 16, 1944.

Examination at that time revealed a large firm mass which occupied an area beneath the right clavicle and extended into the axilla (Fig. 9, A). The mass was expansile and a definite systolic bruit

TABLE I—LOCATION AND NUMBER OF PATIENTS TREATED BY ENDOANEURYSMORRHAPHY

	Cases
Axillary	5
Brachial	14
Femoral	
Iliac	2
Peroneal	
Popliteal	7
Profunda femoris	3
Radial	4
Superior gluteal	
Tibial, anterior	3
Tibial, posterior	8
Ulnar	—
T tal	6



Fig 5 Case 1 a, left. Preoperative photograph. Aneurysm of gluteal artery b, Postoperative photograph showing incision.

could be heard over it. There was evidence of extensive injury to the nerves of the right arm. Pulsation on the right radial artery was faint.

On June 25 1944, because of a rapid increase in size of the aneurysm, operation was performed. An attempt was made to isolate the subclavian artery above the clavicle but it could not be reached because the clavicle was pushed upward by the aneurysm (Fig 9 b). Since it was believed that the clavicle formed a part of the sac wall it was decided

that it was best not to resect it in order to reach the subclavian artery (Fig 9 c). An incision was therefore made across the axilla and the sac was exposed, opened, and approximately 2000 cubic centimeters of blood and clot were evacuated. Bleeding was profuse but was controlled by finger pressure over two openings in the bottom of the sac. These openings were closed with interrupted sutures of silk. Because of the necrotic appearance of the sac and the large dead space which could not be obliterated a

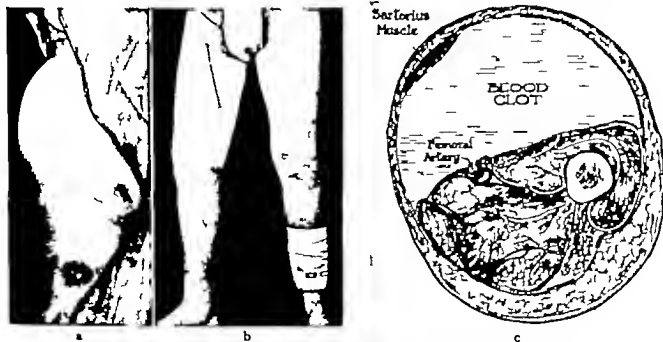


Fig 6. Case 2 a, Preoperative photograph. Aneurysm of right femoral artery b, Postoperative photograph showing incisions. The upper transverse incision was made

for temporary occlusion of the femoral artery c, Cross section illustration showing relative size and position of aneurysm

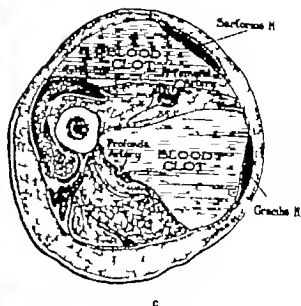


Fig. 7. Case 3. a, Preoperative photograph. Double aneurysm of femoral and profunda femoris arteries. b, Postoperative photograph showing incisions. The

upper transverse incision was made in order temporarily to occlude the common femoral artery. c, Cross section illustration showing relative size and position of aneurysms.

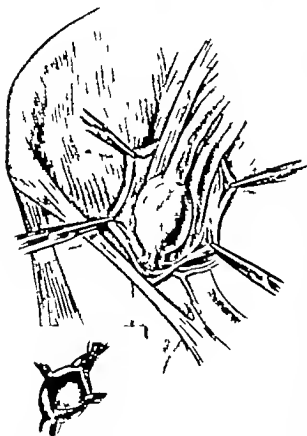


Fig. 8. Diagrammatic illustration showing operative procedure used in Case 4.

drain was left in the wound for 24 hours. His recovery was uneventful. The hand and fingers have remained warm. Two months later nerve repair of the radial, median, and ulnar nerves was done. At present there is evidence of returning nerve function.

CASE 6 False aneurysm, right brachial artery due to mortar shell fragment wound incurred August 6, 1944. Endoaneurysmorrhaphy right brachial artery lower third December 13, 1944. Recovery.

This 23 year old soldier was wounded by mortar shell fragment on August 6, 1944. The fragment entered the posterior surface of the forearm just below the elbow and caused a compound fracture of the ulna. Bleeding was slight and controlled by a pressure bandage. At the same time he sustained an injury to the median nerve which was partial and from which he gradually recovered. At an evacuation hospital in England the wound was debrided, a plaster splint applied and he was returned to the United States. With the removal of the splint, an aneurysm was discovered just below the bend of the right elbow and for this he was admitted to Ashford General Hospital on December 5, 1944.

On admission he complained of pain and throbbing sensation in his right hand. Examination revealed a partial paralysis of the median nerve which was indicated by weakness of the muscles supplied by that nerve but which was said to be improving. Just distal to the right antecubital space was a fluctuant mass about 5 centimeters in diameter (Fig. 10a). There was no thrill, but a systolic bruit could be heard over it. Skin temperatures of both hands were normal and symmetrical, although the right radial pulse was diminished in comparison with the left.

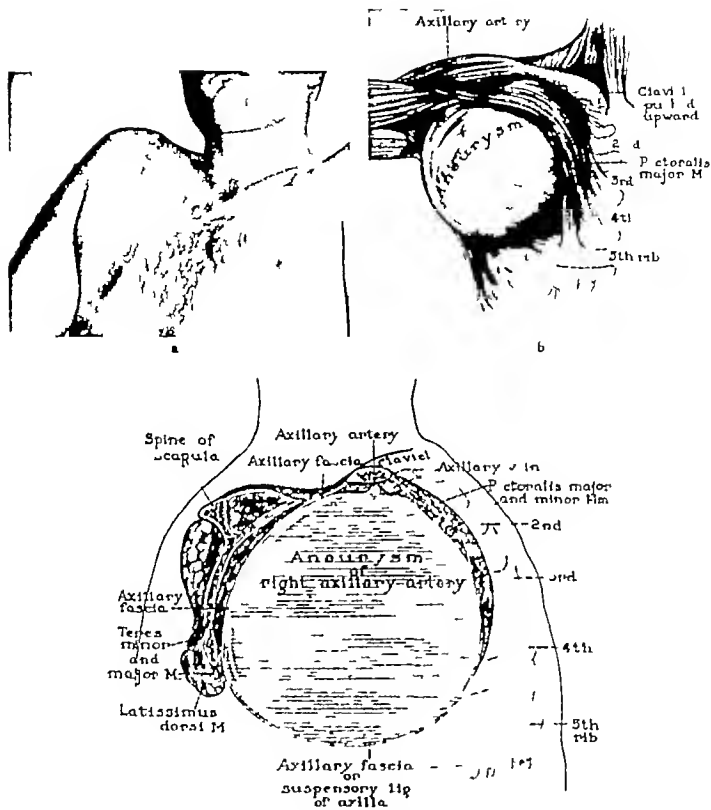


Fig. 9. Case 3. a. Preoperative photograph. Aneurysm of axillary artery. b. The approximate anatomic position of the aneurysm. c. Cross section showing relative size and position of aneurysm.

On December 13, 1914, operation was done under pentothal sodium anesthesia. A blood pressure cuff was used as a tourniquet on the arm. An incision 5 centimeters in length was made directly over the

aneurysm and the sac uncovered (Fig. 10 b). A laminated clot together with fresh clot was evacuated. At the bottom of the sac the brachial artery was easily located. There were two openings in it 1

centimeter apart. Both were closed with interrupted sutures of silk. When the tourniquet was removed there was no abnormal bleeding. The deep fascia and skin were closed with interrupted sutures of silk. No attempt was made to obliterate the sac other than to apply a snug pressure bandage. Circulation in the hand and fingers was good at the end of the operation and remained so. Function of the median nerve returned without further operation.

CASE 7 False aneurysm left radial artery upper third due to high explosive shell fragment wound incurred October 7 1944. Endoaneurysmorrhaphy June 16 1945 Recovery

This 23 year old soldier was wounded in action October 7 1944. He suffered wounds of both upper extremities, the abdomen, and chest. He was operated upon within a few hours for perforations of the ileum and liver from which he recovered without difficulty. After returning to the United States in May the patient first noticed a pulsating tumor of the left forearm, and for this he was admitted to Ashford General Hospital on June 8 1945. On examination there were noted numerous healed scars of both upper extremities, chest, and abdomen. On the lateral volar aspect of the left forearm there was a circumscribed pulsating tumor about 6 centimeters in diameter. Over this mass a systolic bruit could be heard. The skin temperatures of the fingers of both hands were normal and symmetrical. The left radial pulse was weak. There was no associated nerve injury (Fig. 11, a and b).

On June 16 1945 operation was performed under pentothal sodium anesthesia. An inflated blood pressure cuff was used as a tourniquet on the arm. A longitudinal incision 5 centimeters long was made



Fig. 2, a.

Fig. 2, b.

(Legend on followi g page.)

directly over the tumor mass which was easily uncovered. The sac was opened and some old and freshly organized clot was evacuated. The radial artery which was at the bottom of the sac had been partially divided producing an upper and lower opening each of which was closed with sutures of silk. The tourniquet was then removed and there was a slight oozing which was closed with another suture of silk. No attempt was made to obliterate the sac. The deep fascia and skin were closed with interrupted sutures of silk and a pressure bandage was applied from the fingers to the elbow. The circulation of the fingers was good at the end of the operation and remained so.

CASE 8 Arteriovenous aneurysm, left external carotid artery and internal jugular vein with false venous sac, due to shell fragment wound incurred September 23 1944. Paralysis of left recurrent laryngeal nerve. Ligation and division of right external carotid artery. Ligation and division of left

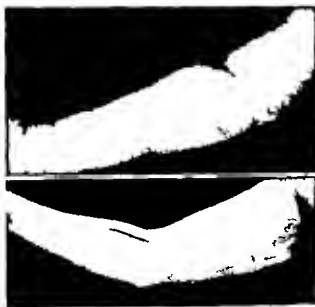


Fig. 10. Case 6. a, above, Preoperative photograph. Aneurysm of brachial artery b, below Postoperative photograph showing incision.



Fig. 11. Case 7. a, above, Preoperative photograph. Aneurysm of radial artery b, below Postoperative photograph showing incision.

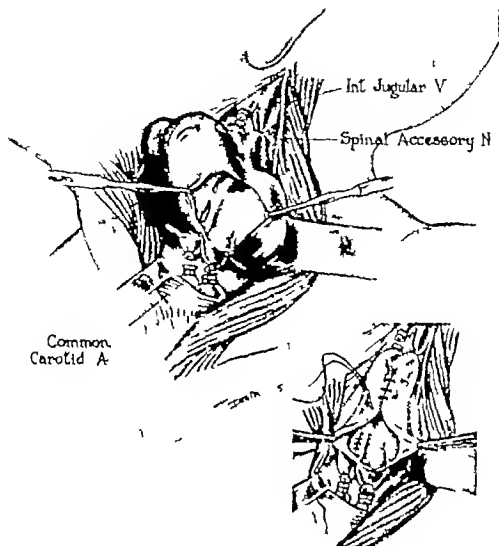


Fig 12 c

Fig 12 Case 8 a, Preoperative photograph. Arteriovenous aneurysm of external carotid artery and internal jugular vein. b Postoperative view showing incision. c, Repair by ligation and division of vessels and transvascular closure of arterial openings.

common carotid artery and internal jugular vein ligation and division of distal arterial branches Endoaneurysmorrhaphy Recovery

This 36 year old soldier was wounded in action by a mortar shell fragment which struck the infra orbital region of his cheek. He was unconscious for approximately 10 days during which time a tracheotomy was performed because of respiratory difficulties. The tracheal tube was removed after 3 weeks. Soon after the injury a mass was noted in the left side of his neck and, on recovery of consciousness, he noticed that the left eyelid drooped and that he was hoarse. He was returned to the United States and admitted to Ashford General Hospital on December 19 1944.

Examination revealed a small wound just below the left eye. Roentgenogram showed a foreign body in the left suprascapular region. There was definite Horner's syndrome on the left and paralysis of the left recurrent laryngeal nerve. In the left side of the

neck extending from the ear almost to the clavicle was a mass of dilated vessels which was easily compressible (Fig 12a).

A harsh continuous bruit accentuated in systole could be heard over the mass and was transmitted to the scalp down the left arm and to the left scapular region. A continuous thrill could be felt over the whole left side of the neck. The bruit and thrill were easily eliminated by compression of the common carotid artery. The mass in the neck became much less tense on obliteration of the artery and the pulse rate fell from 92 to 76 and the blood pressure changed from 110/70 to 110/84. Diagnosis of an arteriovenous fistula of the external carotid artery and internal jugular vein together with false venous sac was made.

Because it was apparent that considerable blood flow to this fistula came from both sides of the neck, preliminary ligation and division of the external carotid artery of the right side were done on Decem-

ber 28 1944. On January 4, 1945 the final operation was carried out under pentothal sodium anesthesia. An incision was made along the anterior border of the sternomastoid muscle from the angle of the jaw to the sternum (Fig. 12 b) and the muscle was retracted laterally. This exposed a tense and dilated venous sac. The common carotid artery was ligated and divided which relieved this tenseness to some extent. By careful dissection about the sac and retraction laterally three branches of the external carotid artery distal to the fistula could be ligated and divided. The internal jugular vein distal to the fistula was ligated. The internal jugular vein on the proximal side of the fistula was then ligated and divided. When this was done it became apparent that the fistula with the false sac could not be completely removed and therefore the sac was opened

and the clot evacuated. There was some bleeding from three openings in the sac which were evidently branches of the external carotid artery. Bleeding from them was easily controlled by the passage of interrupted sutures of silk. A portion of the sac wall was excised and the remainder was imbricated over the previously closed arterial openings (Fig. 12 c). The deep fascia and skin were closed with interrupted sutures of silk. The operation required 6½ hours. The patient's condition throughout the operation was good and there was no difficulty in his breathing. Following the operation there was considerable difficulty in his breathing and swallowing but from this he recovered gradually within a period of a week. A month later he was discharged from the service with considerable improvement in his hoarseness but none in sympathetic paralysis.

WAR INJURIES OF THE CHEST

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AN ANALYSIS of a large series of cases having war injuries of the chest as observed in an Army Chest Center in this country seems desirable. Reports on the early phases of chest injuries have been published (1, 2). The present analysis represents a study in retrospect of the first 500 consecutive patients in 2350 such patients seen. The material for this study was obtained from a careful review of the patients' field medical records, records of previous hospitalizations, and serial roentgenograms as presented by the patients at the time of admission to a chest surgical center in the Zone of the Interior. The course of such chest injuries is viewed from the point of vantage of their last hospitalization. These cases were analyzed as to the character of the original injury, initial treatment, complications, and subsequent treatment. An evaluation of operative and conservative therapy is made. Closure of thoracotomy wounds with and without drainage is discussed in relation to postoperative morbidity. Other aspects of the treatment of war chest injuries have been thoroughly covered in previous papers and will not be repeated. Such an analysis as this is felt to be of value in the treatment of similar injuries in the future. The condition of the patients upon arrival in this country as well as the more important phases of late treatment is described.

The lowered mortality from chest wounds in this war has been due to their excellent primary care. Chemotherapy and penicillin have aided but in themselves are no substitutes for sound surgical judgment. In some cases they may be detrimental to the patient's welfare if dependence on their protective ability leads the surgeon to take unnecessary risks.

Even though the mortality has been remarkably decreased from that in previous

years the morbidity could be further reduced. Several factors have contributed to the present morbidity. Among the factors to be discussed are (1) the delayed or ineffectual aspiration of hemothoraces; (2) the tendency to close contaminated chest wounds primarily without drainage; (3) ill timed or unwise thoracotomy; and (4) the tight closure of sucking wounds of the chest in the face of underlying bronchopulmonary fistulas.

The early treatment of chest wounds should be concerned primarily with the correction of the altered cardiorespiratory mechanism contributing to the shock of the patient and with the prevention of infection. There are only a few chest conditions which require immediate surgical intervention. These are large sucking wounds of the chest wall, tension pneumothorax, and uncontrollable bleeding. However, many emergency operations have been performed where these conditions have not existed. Many chest injuries fare better when they are treated by repeated, effectual thoracenteses. The type of injury as well as the nature of the offending agent is of importance in the decision as to immediate thoracotomy.

Certainly in explosive injuries causing large sucking wounds, hemorrhage, and extensive laceration of the lung with retained spicules of rib clothing and metal, thoracotomy is indicated. However, these comprise only a small proportion of the injuries seen.

ANALYSIS OF THE INITIAL CHEST CONDITIONS

The causative agent in the majority of cases was either shrapnel or shell fragments. A minority of the injuries was due to bullets. Table I lists the types of the initial conditions in 500 patients.

Hemothorax or hemopneumothorax of some degree occurred in 455 of the 500 patients with chest injuries. It is interesting to note that 19 patients with either perforating or penetrating wounds of the chest escaped without devel-

From the Thoracic Surgery Section, Kennedy General Hospital, Memphis, Tennessee.

TABLE I.—ANALYSIS OF INITIAL CHEST CONDITIONS*

Condition	N. of cases
Hemothorax	455
Significant foreign bodies	21
Sucking wounds	36
Combined chest-abdominal wounds	75
Bronchopleural fistulas	45
Penetrating or perforating injuries only	9
Lung contusion	5
Pericarditis with effusion	0
Tension pneumothorax	9
Blast injuries	8
Hematoma of the lung	4
Fractured sternum	4
Injuries to the esophagus	3
Injuries to the trachea	3

*The occurrence of some of these injuries may have been higher had no reference been made to them in the records available.

oping any detectable hemothorax. There were 211 retained foreign bodies. There were many more than this noted by roentgen examination but their size and location were such as not to be of clinical significance. One hundred and thirty-six sucking wounds of the chest wall were of such a degree as to require immediate closure. There were 62 extensive lacerations of the lung and 45 clinically significant bronchopleural fistulas. Transitory fistulas must have been present in other cases but apparently were not complicating factors. There were 75 combined chest-abdominal injuries. In several instances multiple abdominal organs were involved. The organs injured in the order of incidence were liver 40, spleen 16, stomach 15, kidney 9, small intestine and colon 7. The other initial injuries are self explanatory as noted in Table I.

The good results being obtained in patients with war chest injuries are due to the excellent organization providing the best care from the onset by the medical corps men and front line surgeons. The immediate use of morphine, tetanus toxoid, plasma, transfusions, sulfonamides, penicillin and followed when indicated by prompt débridement, thoracentesis and exploratory thoracotomy have saved many lives that would otherwise have been lost.

Four hundred and fifty five patients had some degree of hemothorax, many of which were associated with other conditions such as sucking wounds, lacerated lung tissue and retained foreign bodies. Others were uncon-

TABLE II.—TREATMENT OF 455 PATIENTS WITH HEMOTHORAX

	Number of cases	Patients developing infection	
		No.	Percent
I Group treated by thoracentesis	225	28	12.4
Eliminating 4 patients with bronchopleural fistulas who became infected	14	07	5
b Eliminating 13 patients (made completely tapped) (-no aspirates) who became infected		5	3
Eliminating groups a and b	201	1	0.5
II Group treated by operation	58	7	12.1
III Group with no definite treatment	7	20	43
Eliminating 6 patients with bronchopleural fistulas who became infected	66	24	36.4
b Eliminating 24 patients with small hemothoraces which healed spontaneously and 6 patients with bronchopleural fistulas	34	21	62

pliated. In a number it was impossible to determine the condition of the intrathoracic organs prior to operation.

The most severely injured patients had thoracotomies. In other instances, patients with less severe injuries were also operated upon. In a comparative analysis in retrospect from material obtained from the field medical records and serial roentgenograms it is difficult properly to evaluate all of the factors confronting the attending surgeon and influencing his decisions as to the type of therapy employed. In discussing results obtained in the treatment of hemothorax by various methods, hemothorax alone will be considered apart from the accompanying conditions. As may be noted in Table II, 225 of the 455 patients with hemothorax were treated conservatively by thoracentesis, 156 had thoracotomies and 74 had no definite treatment.

Results obtained with and without thoracentesis. The effectiveness of adequate repeated thoracenteses in the treatment of hemothorax is emphasized by the data in Table II. It is important to note that only 16.8 per cent of hemothoraces aspirated became infected, in comparison to 45.9 per cent of those not aspirated. The difference in the results obtained is even more striking if patients with bronchopleural fistulas and inadequate thora-



Fig. 1 a, A hemothorax secondary to a perforating wound of the right chest. b, The chest a few days following thoracotomy and hemostasis. No thoracotomy drainage

was employed because the amount of contamination was thought to be minimal. c, A fluid level in the right hemithorax indicative of a postoperative empyema.

centeses (only 1 to 2 aspirations) are eliminated from the first group. An incidence of infection of 6.9 per cent results in patients adequately treated. This may be compared to the second group in which thoracentesis was not used. If 6 patients with broncho-pulmonary fistulas are eliminated and 34 patients with only small collections of blood in the pleural space are not considered, an incidence of infection of 70 per cent results.

Operative versus conservative therapy in initial chest injury. Considerable advance has been made in thoracic surgery since the last war. The lowered mortality from chest wounds is, in part, due to the ability of present day surgeons to cope successfully with intrathoracic operations. However, as previously stated, there are only certain indications for immediate thoracotomy. The presence of a penetrating or perforating wound of the chest in itself is not an indication. Many operations designed to stop hemorrhage or to prevent infection have instead been followed by these as complications (Fig. 1). This is particularly apt to be true if the chest is closed without drainage.

One hundred fifty-six patients had initial thoracotomy débridement, hemostasis, and repair of the injured tissues within the first 24 to 48 hours. Of these 156 cases, 48.7 per cent were complicated by an infected hemothorax (Table II). 30 per cent by hemothorax relieved by thoracentesis and 6 per cent by

organized hemothorax. According to these figures, the operative group fared much worse than the group followed conservatively with thoracenteses, in which only 16.8 per cent of the patients required additional treatment. It is realized that the operative group included the severe injuries in which operative therapy was mandatory and the likelihood of complications great if operation had not been done, but it also included patients who would have done as well or better on conservative therapy alone. Of the 156 patients having early thoracotomies, in 66 no obvious indication for immediate operation could be found in their field medical records. The majority of these had retained foreign bodies in addition to a hemothorax. Sixteen patients were found at the time of operation to have lacerated lung tissue. A number of these patients had their wounds closed without drainage and did not receive adequate postoperative thoracenteses. Many of these patients developed infection which required drainage (Fig. 2). No mention is made of chemotherapy (sulfonamides and penicillin) for this was employed in all groups.

Comparison of results obtained in patients having thoracotomies closed with drainage and without drainage. There were 189 patients in all who had thoracotomies prior to arrival in this country. This includes 33 patients who were operated upon at a later date in addition to the initial 156. In 81 patients wounds were closed with drainage and in 108 without. In



Fig. 2. Roentgenograms illustrating penetrating bullet wound of the left chest. The bullet is noted in the left apex. An immediate thoracotomy was performed for hemostasis and to remove the bullet. The bullet was so located in the mediastinum as to prevent its removal. The chest was closed without drainage. a, A postoperative hemothorax. This later became infected and was treated by open thoracotomy drainage. b, The resulting total empyema space.



Fig. 3. Roentgenograms illustrating penetrating wound of the right chest resulting in retained shell fragment and a hemothorax. a, Condition of chest prior to operation. b, A postoperative pneumothorax secondary to a bronchopleural fistula. The wound was closed without drainage and an empyema resulted that required drainage on three occasions.

those closed with drainage 82.7 per cent healed without requiring secondary operations in contrast to only 43.5 per cent of those closed without drainage.

The patients who were drained and yet became infected had the most severe injuries. There was an average length of healing in the first group of 10 weeks as compared to 14 weeks in the second group. Even though 43.5 per cent of the patients closed without drain-

age healed primarily the higher incidence of postoperative infection requiring secondary operations and the longer period of convalescence in those who became infected makes this type of treatment less desirable than the use of postoperative drainage.

Conditions under which a surgeon must care for the wounded at the battlefield do not always allow him to supervise the postoperative care for a sufficiently long period of

TABLE III.—THORACOTOMIES CLOSED WITH AND WITHOUT DRAINAGE

	Closed with drainage 81	Closed without drainage 108
Number of cases		
Percentage healing without secondary operations	82.7	43.5
Percentage requiring secondary operations	17.3	56.5
Average duration of healing	10 weeks	14 weeks

time, nor allow the thorough aspirations of a hemothorax before the patient must be evacuated elsewhere. It seems far safer therefore to employ routinely water seal drainage after thoracotomies. This would be followed by less risk to life and lowered morbidity and would require considerably less of the surgeon's time and attention than would repeated post-operative thoracenteses. During transportation the thoracotomy tube could be clamped and the bottle temporarily disconnected or a flapper type drain used.

Foreign bodies. Of the original 211 retained foreign bodies, 47 were removed at the time of the original operation and 33 after an interval of several weeks. In many patients the foreign body was removed incidental to débridement, hemostasis and repair of lacerated lung tissue while in others the operation was designed primarily for the removal of the foreign body. In this latter group the chest was frequently closed without drainage because the extent of injury was not great. In the process of removing the foreign body bronchopleural fistulas frequently were created and these were not adequately repaired, as demonstrated in Figure 3. The incidence of postoperative infection in this group alone was 30 per cent.

There is considerable difference of opinion as to the clinical significance of metallic foreign bodies and the indications for their removal. The chief reason for removing pulmonary foreign bodies is the possible development of hemorrhage or infection. Of the entire group only 8 were later associated with hemoptysis, 7 with lung abscesses, 6 with pneumonitis and 8 with draining sinuses. These conditions occurred for the most part within 2 to 4 weeks following injury. Those foreign bodies associated with infection were usually found at operation to be intermingled with other debris such as particles of clothing

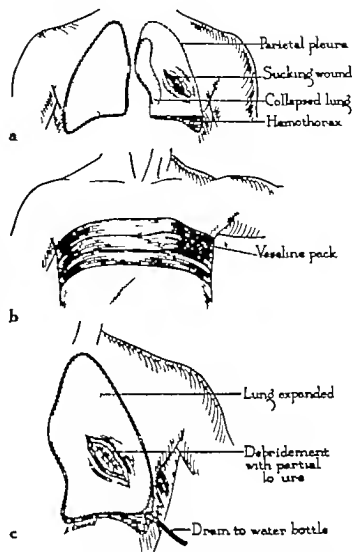


Fig. 4. Diagrammatic illustration of the emergency treatment, b, by packing with vaseline gauze and tight application of adhesive tape to sucking wound illustrated in a. c, Diagrammatic demonstration of the definitive treatment of sucking wounds of the chest wall by débridement and partial closure including the pleura and muscle layer but leaving subcutaneous adipose tissue and skin open. An intercostal water seal thoracotomy tube is inserted to drain the inevitable hemothorax.

and dirt which probably was the cause of the infection rather than the metallic foreign body itself. Only experience over a longer period of time will enable the surgeon to evaluate the late results of residual foreign bodies and the advisability of their removal.

SUCKING WOUNDS OF THE CHEST WALL

There were many more sucking wounds of the chest wall than the 136 listed but these were small enough to be of no clinical significance and responded promptly to either packing or débridement and primary closure.



Fig. 5. Serial roentgenograms. a. An early infected hemothorax with mediastinal shift to the opposite side. b. A residual empyema space following early open

thoracotomy drainage. The appearance of the healed chest following continuous suction therapy over a period of 4 months.

There was between 5 to 10 per cent infection in such wounds closed primarily. In several instances tension pneumothorax developed after closure of the sucking wound when underlying bronchopleural fistulas were not recognized. In the larger sucking wounds of the chest wall emergency closure by packing was followed almost universally by débridement and primary closure. Fifty-seven per cent had thoracotomies in addition to closure of the sucking wounds. Several patients with sucking wounds had only partial closure of the chest wall following débridement in conjunction with intercostal water seal drainage as demonstrated in Figure 4. The convalescence of these patients was the least complicated of all.

INJURIES TO THE ESOPHAGUS AND TRACHEA

There were 3 injuries to the cervical esophagus and 2 to the upper end of the trachea in the first 500 patients analyzed. Eight additional cases have since been seen. No injury to the thoracic esophagus was noted even though in a number of instances ragged shell fragments have lodged in the posterior mediastinum close to the esophagus (Fig. 8d). The high mortality resulting from mediastinitis and hemorrhage associated with such injuries accounts for the few patients seen in the Zone of the Interior. Three patients had immediate tracheotomies and 4 patients gastrostomies within 4 to 10 days time. All of these injuries were complicated by esophageal fistulas and abscesses requiring drainage.



Fig. 6. Roentgenograms demonstrating a. an infected organized hemothorax and b. the postoperative result following decortication.

TABLE IV—COMPLICATIONS (CHEST)

Complications	N
Infected hemothorax	144
Hemothorax	47
Organized hemothorax	49
Bronchopleural fistula	36
Subphrenic abscess	12
Pneumonitis and lung abscess about foreign body	11
Tension pneumothorax	9
Pneumonitis and abscess at site of hematoma	4
Infected costal cartilage	7
Atelectasis	9
Pulmonary infarct	3
Bronchopneumonia	5
Hemoptysis secondary to foreign body	8
Pericarditis with effusion	8
Suppurative pericarditis	2
Pericardial tamponade	1
Esophageal fistula with paracervical abscess	3
Diaphragmatic hernia	5

Two patients developed esophageal strictures requiring dilatation. The tracheotomy tubes were removed within 3 to 4 weeks with no further difficulty in breathing. Four of the 6 patients also had recurrent laryngeal nerve paralysis that persisted. The eventual outcome in these 6 patients was satisfactory.

COMBINED CHEST ABDOMINAL INJURIES

The majority of the chest abdominal injuries were successfully treated through a transthoracic approach. Others were explored through the abdomen. In case of doubt as to the extent and location of the abdominal injury the abdominal approach allows better exploration. The diagnosis of a concomitant abdominal injury is frequently difficult to make for diaphragmatic and intercostal irritation frequently give abdominal pain, tenderness and muscle spasm. In combined injuries the abdomen deserves primary attention if the chest is stable. Only when large sucking wounds of the chest wall, tension pneumothorax, pericardial tamponade or rapidly developing hemothorax associated with shock not relieved by conservative therapy are present should the chest condition be given first consideration. Intratracheal anesthesia should be employed in all operations for combined chest-abdominal injuries regardless of approach for if there is a tear of the diaphragm atmospheric air from the abdominal incision may cause collapse of the lung on the affected side and even tension pneumothorax. When injuries to the liver are explored transpleur-



Fig. 7. Roentgenogram demonstrating lipiodol visualization of bronchopleural fistula, narrow empyema tract, and drainage site some distance from fistula.

ally both the subphrenic and pleural space should be drained. When this precaution is not taken bile empyema and subphrenic abscess are frequent developments. Bile empyema occurred in 14 instances. The most significant ones followed closure of the wound without drainage.

The liver appears to tolerate the presence of metallic foreign bodies very well. Liver abscess secondary to a metallic foreign body was not noted in this series even though biliary drainage was present following injury in a number of patients. In injuries to the lower chest careful urinalysis for the presence of blood is indicated. Intravenous pyelograms have occasionally illustrated defects in the renal pelvis secondary to such injuries.

Complications—chest. Infected hemothorax was the largest single complication. Fifty-three per cent of 144 cases were secondary to thoracotomies. Many of the thoracotomy wounds were closed without drainage and because of the necessity of evacuation to other hospitals thoracostomies were often delayed or infrequent. Forty-seven patients developed postoperative hemothorax. All of this group responded favorably with repeated aspirations. Forty-nine patients developed organized hemothorax. Twenty of these had only one aspiration or none at all and 7 had only two aspirations. 9 followed previous thoracotomies.

The majority of the 36 bronchopleural fistulas were secondary to severe injuries. 8 were secondary to removal of foreign bodies and 6 were noted only after the development of



Fig. 8. Roentgenograms demonstrating pneumonia and abscess. b and c, foreign bodies in contact with the esophagus. d, foreign body associated with pneumonia.

empyema. Eleven patients had roentgen evidence of either pneumonia or lung abscess at the site of foreign bodies. In 4 patients pulmonary hematomas became infected, liquefied and required drainage. The other complications are self-explanatory as noted in Table IV. The surgical treatment of the complications is tabulated in Table V as follows:

TABLE V.—TREATMENT OF COMPLICATIONS

Treatment	No. cases
Thoracentesis	47
Drainage empyema	5
Radical resection	46
Decortication	49
Closure bronchopleural fistula	0
Drainage subphrenic abscess	2
Repair of diaphragmatic hernia	3
Drainage lung abscess	3
Pericardial pericarditis	1
Drainage suppurative pericarditis	2
Drainage pericardial tamponade	4
Resection of osteochondritis	4

EMPYEMA

Etiology of empyema. One hundred fifty-one patients developed empyema secondary to the chest injury. In some, several factors appeared to contribute, such as bronchopleural fistula or extensive injury with considerable contamination in patients whose wounds were closed without drainage following operation. In 41.2 per cent the cause was directly concerned with some aspect of the injury such as its severity, extensive contamination or laceration of the lung with bronchopleural fistula. In 58.8 per cent failure to provide adequate aspiration of a hemothorax in the nonoperative cases or postoperative water seal drainage in the operative group was responsible, either wholly or in part, for the development of the empyema. Of this 58.8 per cent 31.4 per cent had thoracenteses

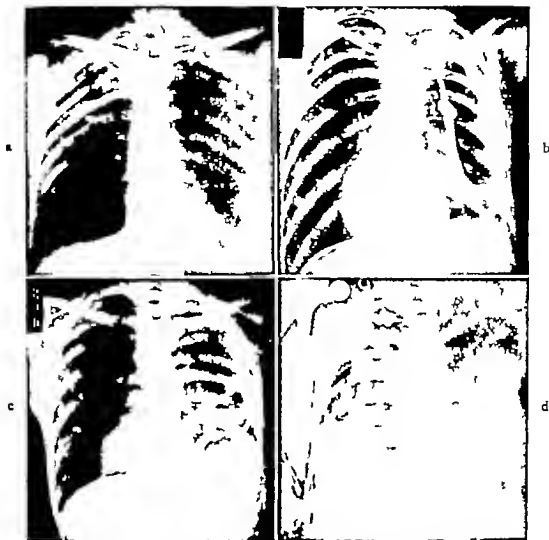


Fig. 9. Roentgenograms demonstrating a, a lung abscess associated with a metallic foreign body. At time of operation clothing and other debris were found in the abscess cavity. b, A large foreign body partially embedded in the lung parenchyma and protruding into the empyema cavity. c and d, Large foreign bodies in the lung parenchyma associated with empyemas.

without postoperative drainage 9.4 per cent too early removal of the thoracotomy tube and 18 per cent inadequate thoracenteses (0-2 aspirations). No patient operated upon developed an empyema of clinical significance as a result of water seal drainage. This analysis suggests that the incidence of empyema could have been appreciably reduced if adequate water seal drainage had been provided. The average interval prior to drainage of the empyema was $3\frac{1}{2}$ weeks.

Condition on admission to chest surgical center. Certain aspects of value in the late treatment of these conditions will be discussed. The majority of the chronic empyemas are adequately drained and in a state of healing when admitted. Those that are not adequately

drained are redrained. Most are either small or moderate in size. During the early phases of the war there was a tendency to perform early open thoracotomy for infected hemothorax. Total empyema spaces were a fire

TABLE VI.—CONDITION ON ADMISSION TO CHEST SURGICAL CENTER

Condition	No. of cases	Percentage
Healed	374	62.8
Chronic empyema	82	16.4
Foreign bodies	49	9.8
Bronchopleural fistula	36	7.2
Draining sinus	26	5.2
Organized hemothorax	12	2.4
Hemothorax	9	1.8
Diaphragmatic hernia	4	0.8
Esophageal fistula and para-esophageal abscess	3	0.6
Pericardial effusion	2	0.4





Fig. 11 Photographic illustrations of a decortication
 a, An organized hemothorax after evacuation of the fibrin
 mass from the pleural space showing the organized

fibrin on visceral pleura b, Easily obtainable cleavage
 plane between fibrous encasement and visceral pleura.
 c, Re-expansion of lung with positive pressure anesthesia.

moved if readily obtainable at the time of drainage (Fig 9) If not then they are removed at a later date if causing a drainage sinus Foreign bodies causing hemoptysis or intercostal pain are removed if it can be shown that the foreign body is directly responsible (Fig 10)

Only occasionally the psychological factors of fear and pain are such as to indicate the removal of a foreign body that would not otherwise be removed Foreign bodies when unaccompanied by other debris have been found at operation to be associated with surprisingly little reaction and no infection Those in contact with large blood vessels have been well encapsulated in fibrous tissue Because of these observations the tendency has been to remove fewer and fewer foreign bodies and then only when indicated Tetanus toxoid is always given preoperatively as well as penicillin which is also continued for 4 to 5 days postoperatively At the time of admission to this center 4 patients still had either pneumonitis or lung abscesses 3 had hemoptysis and 4 had draining sinuses The onset in most of these was shortly after injury No evidence of infection has as yet been seen to develop in those patients having retained foreign bodies shown roentgenologically to be free of infection for as long as 2 to 3 months Two patients

bad gross hemoptysis 6 months to a year after injury

Decortication in cases of organized hemothorax has enjoyed considerable popularity and is indeed responsible for the amazing results obtained in many individuals who would otherwise have suffered from a chronic fibrothorax In 8 per cent of the hemothorax patients clotting of the blood occurred to the extent of preventing evacuation of the blood by aspiration In neglected cases the lung is compressed against the mediastinum by an encasement of organized fibrin which prevents the lung from re-expanding immobilizes the diaphragm and lines the parietal surface This layer of fibrin in some instances may be 15 centimeters in thickness The pleural cavity usually contains a jelly like fibrinous mass The operation of decortication as shown (Fig 11) consists of developing an easily obtainable cleavage plane between the fibrous encasement and the adjacent visceral pleura pericardium diaphragm and chest wall from which it can be easily separated allowing re-expansion of the lung When this layer is first incised as shown in Fig 11 b the line of incision quickly gaps and lung tissue herniates through the opening The best results are those done early (4 to 6 weeks) After the lung has been allowed to remain collapsed for

3 months or more some fibrosis of the parenchyma frequently takes place causing delayed postoperative re-expansion

SUMMARY

An analysis of 500 consecutive patients with war injuries of the chest is presented. The course of these injuries is viewed from the point of vantage of their last hospitalization. The material for the study was obtained from a careful review of the patients' field medical records, records of previous hospitalizations and serial roentgenograms as presented by the patients at the time of admission to a chest surgical center in the Zone of the Interior. The character of the original injury, initial treatment and complications are described. An evaluation of operative and conservative therapy of chest injuries is made.

Closure of thoracotomy wounds with and without drainage is discussed in relation to postoperative morbidity. The condition of the patients upon arrival in this country as well as the more important phases of late treatment is described.

The effectiveness of repeated thoracentesis in the treatment of 225 patients with hemothorax is apparent in the incidence of infection of only 16.8 per cent as compared to an incidence of infection of 45.9 per cent in 74 patients not aspirated.

Early thoracotomies employed in the treatment of chest injuries designed to stop hemorrhage or to prevent infection have frequently been followed by these as complications. This is particularly apt to be true if the chest is

closed without drainage. Of the 156 initial thoracotomies 48.7 per cent were complicated by an infected hemothorax, 30 per cent by a hemothorax and 6 per cent by an organized hemothorax. The operative group includes the more severe injuries and the likelihood of complications is greater, but it also includes a number of patients that could have been treated as well by conservative means.

The advantage of postoperative water seal drainage over primary closure of thoracotomy operations without providing drainage is demonstrated by an incidence of healing without requiring secondary operations of 82.7 per cent in patients drained in contrast to only 43.5 per cent in those not drained. Conditions under which a surgeon must care for the wounded at the battle front does not always allow time to supervise the postoperative care for a sufficiently long period of time nor allow the thorough aspirations of a hemothorax before the patient must be evacuated elsewhere. It seems far safer therefore to employ water seal drainage routinely after such thoracotomies.

The treatment of foreign bodies sucking wounds of the chest wall, injuries to the esophagus and trachea, as well as combined chest abdominal injuries is discussed.

The late treatment of chronic empyema, bronchopleural fistulas, intrathoracic foreign bodies and organized hemothorax is described.

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INTRAVENOUS GELATIN FOR NUTRITIONAL PURPOSES

Clinical and Experimental Studies

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GELATIN is an incomplete protein since it does not include all the amino acids essential for normal growth and reproduction. Recently certain gelatins have been employed in the treatment of shock as a plasma or "blood substitute." The following report is concerned with animal experiments and clinical studies employing gelatin as a parenteral nitrogenous nutriment.

The gelatin employed has been previously described.¹ It was prepared from pigskin autoclaved several times and made up into an 8 per cent solution in normal saline.

As the purpose of this study was to determine whether intravenous gelatin is utilized for synthesis of the organism's own proteins (plasma proteins in particular) certain control studies were necessary. Since gelatin is a colloid, the first step was to observe the effects of repeated intravenous injections of an inert non nitrogenous colloid. Gum acacia, 6 per cent in saline was injected daily intravenously in 2 dogs weighing 7.7 and 7.1 kilograms respectively. The quantities injected varied from 200 to 400 cubic centimeters. The hematocrit readings prior to injection were 39 per cent and 35 per cent, respectively. After 6 days these values fell to 14 per cent in each instance. The preliminary plasma protein levels were 5.1 and 5.65 grams per cent respectively, and after 8 days' injection fell to 2.27 and 1.57 grams per cent, respectively, and were maintained at these levels by repeated injections. The reduction in levels of circulating plasma proteins paralleled roughly the reductions in hematocrit readings. Brom sulfalein liver function test in 1 animal after 13 days' injection was within normal limits. These studies were interpreted to indicate that an inert colloid could be injected to dilute

the blood plasma and that plasma protein levels were correspondingly reduced because outpouring of plasma from the tissues into the circulation. If it did occur at all, was insufficient to elevate the plasma protein level above that expected from the dilution.

Another control observation was the determination of the dilution effects of gelatin injected daily as has been described. It was not anticipated that gelatin alone would suffice as an efficient nutriment since it does not include all essential amino acids. It was necessary however to determine if gelatin repeatedly injected would afford hemodilution as did gum acacia. The data obtained in 2 animals are summarized in Table I. Prior to these experiments the animals were depleted of protein by maintenance on a low nitrogen diet (1 gm. of the diet contained 1 mgm. nitrogen).

The results show that hemodilution resulting from repeated injections of gelatin is not comparable in degree with that observed following gum acacia, in that the latter probably remains in the circulation for a longer period.

Still another type of control observation carried out was the demonstration that gelatin injected intravenously was not inert but was at least partially catabolized by the organism. For example in 1 patient receiving nothing by mouth and only saline solution by vein the average daily urea nitrogen excretion was 2.8 grams for 3 days when 11 grams of gelatin were injected each day for 3 days, the average daily urea nitrogen excretion was 7.5 grams and on the subsequent 3 days when saline only was again injected the urea nitrogen excretion was 3.2 grams per day. Explanations other than that the increased urea excretion was derived from catabolism of some of the gelatin would appear farfetched.

In a study to determine the utilization of a given nutriment administered intravenously it is necessary to determine its efficiency when

Brunschwig, A., Corbin, N. and Johnston, C.D. Ann. Surg. 93, 7 & 1918-1920.
From the Department of Surgery University of Chicago.

Patient K., No. 344120, female, aged 34 years, convalescent from a radical colectomy and enterectomy performed for extensive regional enteritis was markedly depleted before operation due to severe diarrhea.

During a period of 7 days observation the following facts were noted

Average daily nitrogen in diet—grams	11.0
Average daily nitrogen (intravenous) gelatin—grams	11.2
Average daily calories in diet	812
Average daily total nitrogen intake—grams	22.2
Average daily nitrogen excretion—grams	14.7
Average daily nitrogen balance	+7.5

The above depleted convalescent patient was enabled rapidly to achieve an average daily positive nitrogen balance of 7.5 grams. Seven months after operation she remains well.

Similar data in another patient again indicate the value of intravenous gelatin in increasing nitrogen retention. A period of 6 days observation while gelatin was administered was followed by a period of 5 days when gelatin was not injected.

Patient R., No. 305306 female, aged 35 years, a convalescent from excision of the head of the pancreas and duodenum for carcinoma of the former. Six months after operation patient is well.

	Period I 6 days	Period II 5 days
Average daily (intravenous) gelatin—grams	1.5	0
Average daily nitrogen in diet—grams	5	7.4
Average daily calories in diet	820	1573
Average daily total nitrogen intake—grams	16.5	7.4
Average daily nitrogen excretion—grams	12.8	6.3
Average daily nitrogen balance—grams	+3.7	+1.1

Data in a third patient who received all nutriment intravenously follow

Patient Nels No. 356063, male, aged 58 years was suffering from carcinomatosis primary in the stomach.

	Period I 9 days	Period II 4 days
Average daily (intravenous) gelatin—grams	11.2	11.2
Average daily nitrogen (intravenous) casein digest—grams	6.0	6.0
Total nitrogen (intravenous)—grams	17.2	17.2
Intravenous glucose—grams	150	200
Average daily nitrogen excretion—grams	16.3	15.3
Average daily nitrogen balance—grams	+7	-4.1

A slight positive nitrogen balance was possible when gelatin and casein digest were injected, whereas when gelatin alone was injected there was pronounced negative balance. This may be explained by the inadequacy of gelatin alone as a nitrogenous nutriment whereas combined with casein digest all essential amino acids were afforded.

DISCUSSION

Parenteral nutrition by means of nitrogenous substances is in its early stages of development. Undoubtedly as progress in this field continues, newer types of solutions will be developed to afford increased efficiency of utilization and to include factors the essentiality of which are not as yet appreciated.

The studies summarized herein indicate that certain gelatins may be employed for the parenteral administration of nitrogen and that nitrogen in such form is anabolically utilized. The principle demonstrated is that a non-antigenic protein may be administered parenterally and is at least partially utilized if essential amino acids which it may not contain are otherwise available.

SUMMARY

Experimental studies in dogs indicate that a certain type of gelatin administered intravenously is at least partially utilized for regeneration of plasma proteins.

Clinical experience indicates that intravenous gelatin constitutes one method by which nitrogenous substances for nutritional purposes may be administered.

INDICATIONS FOR ROENTGEN THERAPY OF BLADDER CARCINOMAS

Recognition of Suitable Cases

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RADIATION therapy of carcinoma of the bladder comprises several procedures external roentgen therapy contact roentgen therapy through the suprapubic wound interstitial irradiation by means of removable radium needles or implantation of radon seeds into the tumor The following discussion deals exclusively with external roentgen therapy of the bladder in an attempt to gain a working basis for indications of this type of treatment in the management of bladder carcinoma in contrast to other radiological and surgical procedures

Roentgen therapy of cancer in general has two distinct aims palliation or permanent cure. Palliative and radical curative roentgen therapy differ fundamentally in indications and technique in spite of the quite widespread misconception that an incomplete course of irradiation might still afford some palliation even if it does not completely sterilize the cancer Usually in such instances the added injury of incomplete irradiation will rather aggravate the condition

Palliative roentgen therapy to be sure has its well defined place in the management of certain incurable cancerous manifestations but its scope is much narrower than is generally assumed and patients have to be selected as carefully as for the radical procedure In the treatment of those cancers of the bladder which are considered incurable by surgical or radical radiological procedures because of the extension of the disease or the general condition radiation therapy with the purpose of palliation only has no place It is useless and in many instances harmful The amount of irradiation necessary to produce sufficient tumor response to cause even an appreciable retardation of growth will, if the tumor remains uncontrolled cause so much discomfort

From the Tumor Institute of the Swedish Hospital, Seattle.

by increased frequency and pain with corresponding deterioration of the general condition that the term "palliative" becomes meaningless. Very occasionally the use of irradiation as a hemostyptic agent may be considered. Usually, however the hemostyptic effect if accomplished at all will be of only very short duration unless a marked actual tumor response is induced. In short the procedure necessary to produce even a temporary tumor regression for the types of cancer encountered in the bladder is of a magnitude out of proportion to its possible results even in cases in which it does not actually aggravate the condition. The damnable practice of giving a few light treatments for psychological reasons in hopeless cases will only discredit the procedure in the minds of those surgeons and urologists who do not yet appreciate the value of radical roentgen therapy for carefully selected suitable cases.

Radical roentgen therapy, in the meaning of this term as we shall presently define it is young. It dates from 1922 when Regaud, Coutard and Hautant demonstrated 6 patients with inoperable cancer of the larynx treated and cured by x ray therapy. For the first time the fact was established that for certain types of tumors radiation therapy is superior to surgery that surgery and radiation therapy do not compete with each other that each procedure has its own indications. The fundamental principle of radical radiation therapy which Coutard has taught us is the careful adaptation of the treatment to the requirements of the individual patient (type of tumor extension general condition, response to treatment) under the guidance of detailed daily examination. In this way—and in this way only—is it possible to push the dose to the necessary tumor sterilizing level without causing intolerable permanent damage to the sur-

rounding structures. During the two decades that followed this fundamental and epochal demonstration we have learned to apply this type of treatment to certain tumors—such as those of the larynx, pharynx, and cervix—with a degree of certainty that their treatment has passed the stage of the clinical experiment and is now considered as a well established clinical procedure not a last resort in hopeless cases. Accumulated experience has taught us to recognize certain factors as decisive for the recognition of suitable cases for the determination of the prognosis and for the actual conduct of therapy: the histological type of the tumor, its exact location and extension and the general condition of the patient. We have learned for example that the all inclusive diagnosis of carcinoma of the larynx is meaningless unless it is qualified by a detailed description of the place of origin (true cord, false cord, epiglottis etc.) and extension (mobility or fixation, invasion of muscle or cartilage etc.)

In the treatment of cancers of the bladder this stage has not yet been reached. In certain instances bladder cancers have responded to roentgen therapy satisfactorily enough to demonstrate the essential radiovulnerability of these tumors and to encourage further attempts. As a whole however it seems from a review of the literature that the treatment has been given in a more or less haphazard and unsystematic fashion in regard to the selection of cases and the technique used. In general one gains the impression that more often than not roentgen therapy in bladder carcinoma is resorted to only as a last attempt after the urologist has failed.

The main reason for this unsatisfactory state of affairs is probably an insufficient co-operation between the urologist and the radiation therapist. As has been pointed out before the fundamental requirement for radical roentgen therapy is a careful adaptation of the procedure to the requirement of the individual case. We have seen radiologists treating bladder carcinomas without ever having looked into these bladders or without having studied the microscopic section of the biopsy. It is impossible to treat adequately a carcinoma of the larynx or cervix without de-

tailed appraisal of the individual situation by the radiotherapist himself: the same is naturally true for carcinoma of the bladder. The personal examination cannot be fully replaced even by the best description. Naturally the radiation therapist cannot be a specialist in all fields but he must have enough working knowledge in the borderline specialties to enable him to interpret intelligently the findings in close collaboration with the respective specialist. In the conduct of treatment for carcinoma of the bladder in comparison to larynx and cervix, we are somewhat handicapped by the impossibility of regular inspection of the local response since of course frequent cystoscopies during and immediately following treatment even in the best hands would aggravate the treatment reaction and induce serious complications. But a detailed preliminary examination by the radiation therapist in collaboration with the urologist is essential.

From the experience with other tumors it can be assumed that probably only certain types of bladder carcinomas, if any, would be suitable for this kind of treatment while others may be more benefited by other procedures such as surgical excision, fulguration or interstitial radium application. Real progress can be expected only by correlating the success or failure with the details of the individual case treated—with respect to type, location, extension of tumor, general condition of the patient, complicating features such as infection and obstruction as well as considering the details of the procedure used.

With these ideas in mind we analyzed in 1941 the 44 cases of carcinoma of the bladder treated in this Institute between 1934 and 1939 with external supervoltage therapy (1). At that time we reached certain tentative conclusions regarding contraindications and indications which since then have been used as a working basis to guide us in the selection of suitable cases. Again in 1942 we reviewed our material of 52 patients treated between 1934 and 1940 (2). A summary of the entire group of patients treated by this procedure during the 10 year period between 1934 and 1943 is given in Table I.

The experience of others (3, 4, 5, 6) as well as our own in certain carcinomas of the blad-

der demonstrates the possibility of cure with external roentgen therapy. The details of the apparently cured cases including photomicrographs were presented in our previous reports. Our increased experience since the first reports has substantiated our conclusions regarding the contraindications for this procedure. Regarding indications we have to modify our conclusions somewhat in so far as we have seen some patients apparently cured who have shown types of tumors originally considered unsuitable for this type of therapy.

In analyzing the failures as well as the successes we are led to the conclusion that 5 main factors seem to be decisive for the indication for roentgen therapy (1) the biological type of tumor (2) extension of the disease (3) general condition of the patient (4) previous therapy of any kind (5) technique of treatment.

THE BIOLOGICAL TYPE OF TUMOR

As in malignant tumors of other organs the biological type of tumor is probably the most important single factor. The possibility of sterilizing certain malignant tumors by ionizing radiation is due to one of nature's whims which has endowed certain normal and abnormal cells with a sensitivity to this type of irradiation. By trial and error on the basis of empirical experience we have learned to recognize certain tumors as radiovulnerable and others as resistant to ionizing irradiation. In carcinoma of the bladder our experience is still too young to make final conclusions. It seems however that the tumors most suitable for irradiation are the papillary carcinomas without invasion of the bladder wall. In our former reports we have stated that all of our patients treated successfully belong to this group. At that time we emphasized that we were not in full agreement with other reports in the literature in which successful treatment of invasive bladder tumors by x ray therapy was reported. During the last years we have had occasion to treat 2 patients who belong in this group and whom we first very reluctantly accepted for treatment because of the invasive character of the tumor. So far they have shown so complete and persistent a disappearance of the tumor that in all likelihood they will remain cured. In these cases the diagnosis

TABLE 1—SUMMARY OF 69 CASES DURING 10 YEAR PERIOD 1934-1943

Year	No treated	No well to date	Dead or alive with active disease	Lost
1934	0	3	3	
1935		7	6	3
1936	1			
1937	2			
1938	0		0	
1939	0		3	
1940	8		7	
1941	0		2	
1942	5		4	
1943	3			
Total	49		35	

of the invasive character was made on the cystoscopic as well as the microscopic evidence. We have however no way to tell whether the invasion in these cases extended into the muscular structures of the bladder or was limited to the mucous membrane itself. Experience with cancers of other organs has shown that the curability decreases with progressive invasion of the adjoining muscular structures. We believe therefore that the most suitable types for radiation therapy are the papillary carcinomas without marked invasion of the bladder wall. It must be kept in mind that this invasion may not be demonstrable at the first cystoscopy or by preliminary biopsy examinations because only the papillary portion of the tumor intruding into the bladder may be resected for biopsy. An experienced urologist however can recognize the bladder wall involvement to a certain degree. The picture may be masked by a secondary inflammatory reaction and in these instances the infiltration may be less real than apparent. On the other hand certain growths can be definitely recognized as infiltrating growths by cystoscopic examination, palpatory findings and histological examination. We do not believe that a cancer of the bladder once it has deeply infiltrated the muscular structures or has extended beyond the bladder itself is still a suitable object for radiation therapy. Some infiltrative growths as long as the infiltration remains fairly superficial may still occasionally be sterilized.

On the other hand we have seen recurrences in cases of very low grade papillary carcinomas (which by some pathologists would be termed papilloma or malignant papilloma) following a course of supposedly adequate therapy. On the basis of this yet very limited experience it would seem that the most suitable carcinomas are the recurrent papillary carcinomas of a moderate degree of differentiation, those which the urologist considers as beyond his control by repeated fulguration.

EXTENSION OF THE DISEASE

From the foregoing discussion it becomes evident that regardless of the type of tumor, the extension of the disease will have a marked effect on the outcome. While naturally cases with demonstrable distant metastases are beyond treatment one might at times be tempted to treat those which locally have extended beyond the bladder proper. If we feel that the invasion of the bladder muscle itself already demarcates the limits of curability by roentgen therapy obviously cases with involvement of the perivesicular structures are beyond therapeutic approach. In former years in practically all patients seen the disease had extended beyond the surgeon's reach. It was for this reason that they were referred for roentgen therapy. During recent years the situation has changed and due to our increased experience with indications and contraindications and in closer co-operation with the urologists we now receive patients for treatment who technically could still be treated by surgical procedures but for whom the urologists now too feel that roentgen therapy may offer a better chance because of the recurrent character of this type of lesion.

GENERAL CONDITION OF THE PATIENT

As in roentgen therapy for other cancer we have seen that the appraisal of the general condition of the patient quite generally is underestimated in the decision as to indications for roentgen therapy. Consequently it is believed that if a patient is unsuitable for surgery because of his general condition roentgen therapy might still be attempted. Very rarely should the general condition be a decisive factor for determination of surgical

versus radiological indications. With the exception of occasional instances of specific contraindications, such as cardiovascular disease which prohibits surgery patients who are refused surgery on account of their general condition will not support a treatment of such magnitude as radiation therapy. In many a physician's mind radiation therapy of cancer still seems to be a kind of glorified ultraviolet or diathermy. It must be realized that radical radiation therapy with the purpose of cure represents a procedure of such formidable magnitude that it will be supported only by patients in good general condition. It is mainly the lack of appreciation of the meaning of the term radical roentgen therapy which leads physicians and patients alike to believe that a few light treatments might accomplish miraculous results. Actually the treatment of a cancer of the bladder requires daily treatment for about 6 to 8 weeks. Following the therapy a bladder reaction will develop leading to frequency of urination and pain. The intensity of this reaction varies within wide limits. It depends partly on the location of the tumor, the condition of the bladder mucosa in general and on the individual sensitivity. If the tumor is located in the dome the reaction usually will be less marked than if it is located in the trigonal region encroaching on the urethral orifice. A tumor located in the lower most portion of the bladder necessitating irradiation of the prostatic urethra will lead to a very marked reaction with considerable distress. The reaction in men usually is more intense than in women. Marked infection of the bladder mucosa outside of the tumorous portion will also markedly increase the intensity of the bladder reaction. If this is associated with a urethral obstruction by either tumor or prostate interfering with bladder drainage the reaction may be so intense that the actual deterioration of the patient's condition becomes dangerous. Frequency and pain under these conditions interferes so markedly with the patient's general condition that it makes the continuance of adequate radiation therapy impossible. We now refuse patients for treatment in whom either a severe infection is present or adequate drainage cannot be established. In cases in which it is possible

to remove either the enlarged prostrate or the occluding tumor mass to re-establish drainage we ask for this procedure prior to roentgen therapy. If the drainage is either adequate from the beginning or is re-established, one might cautiously begin radiation therapy for the accompanying infection. The treatment itself in some cases may improve the infection at which time the more intense therapy for the carcinoma can be established. However if we do not succeed in combating the infection before the more intense roentgen therapy begins we are very soon handicapped in the adequate conduct of treatment which will not be successful.

From this discussion it becomes evident that patients in a poor general condition are not suitable objects for this kind of therapy. We have found however, that age in itself in an otherwise well preserved body without accompanying infection and not too far advanced disease does not represent an absolute contraindication to the treatment.

PREVIOUS THERAPY

Suprapubic operation preceding roentgen therapy considerably lowers the possibility of adequate irradiation. We have observed the breakdown of a suprapubic scar shortly after irradiation in 2 patients. In both cases the contributing factor to the breakdown could be found in an increased intravascular pressure from interference with adequate drainage. We believe however that in spite of these additional difficulties the previous suprapubic operation itself is a severe handicap to adequate irradiation. If roentgen therapy is considered we feel therefore that either a suprapubic cystotomy should be avoided or should be done high enough to keep the scar outside the field of irradiation. This latter procedure may sometimes be used when an attempt at suprapubic resection may be preferable yet a recurrence of a type of carcinoma suitable for roentgen therapy later on may be considered.

Occasionally patients have been referred after unsuccessful treatment by means of interstitial irradiation. As in all other kinds of carcinoma these patients are not suitable for further irradiation. Cancer therapy by irradiation is an all or none procedure. If the first

attempt fails success can practically never be expected by further irradiation. The tissues do not tolerate the dose necessary for sterilization of the tumor after they have received previous radiation therapy. The tumor itself has become more radioresistant and due to fibrosis is less amenable to further irradiation. If interstitial irradiation has been given by means of permanently implanted seeds the presence of the metal with a secondary irradiation in its immediate neighborhood will add to the necrotic effect of the irradiation and jeopardize the treatment even more than previous radiation therapy by other procedures. It is obvious therefore that these patients should be refused for roentgen therapy.

The situation is somewhat different with regard to previous fulguration. Indeed the most favorable cases for roentgen therapy of the bladder are apparently those that show recurrent papillary carcinoma. In these instances fulguration has usually been attempted and the patient is referred at a time when the recurrence becomes either too widespread or develops too rapidly for further fulguration. These cases are still suitable for roentgen therapy provided the growth has not invaded too far into the bladder wall. If roentgen therapy is considered it should not be done immediately following a recent fulguration. If in a case in which fulguration has been done once or twice roentgen therapy is considered for a new recurrence the surgeon should refer this patient for radiation therapy without any further attempts to fulgurate. The necrosis following fulguration will only intensify the bladder reaction and complicate the proper conduct of therapy.

TECHNIQUE OF TREATMENT

We do not intend to discuss the technical details of the therapy but we wish to emphasize a few points which we believe have been the cause of failures in a number of our cases. The main technical errors which may lead to failure in cases primarily considered as curable lesions may be due to misjudgment of the field size in relation to the tumor or to insufficient or too rapid treatment. Led by cystoscopic examination which showed the tumor area limited to one side of the bladder we have

tried to increase the dose to this area with corresponding diminution of the dose on the contralateral portion. We have abandoned this procedure because we have observed definite progression of the tumor on the under treated side. It is probably not possible to judge exactly the limitation of the field in the bladder itself and it is necessary to include the entire bladder in the field during the whole course of treatment. Furthermore it seems necessary to treat the entire bladder in the recurrent papillary growth (the most suitable type for roentgen therapy) in order to prevent recurrences in other parts of the mucosa.

In one case we have observed recurrence of a papillary carcinoma in the lowermost portion of the trigone close to the bladder neck while the remaining bladder remained clear throughout the observation time. Since we had no other reasons to explain this localized recurrence we feel that in all likelihood it was due to an underdose in this most peripheral area of the field.

In 2 cases of our series a severe pelvic fibrosis developed undoubtedly due to overtreatment. In 1 case the bladder capacity became so reduced due to the bladder fibrosis that a transplantation of the ureters was found necessary. In this case the ureters were found dilated to about 4 times normal size and the kidney pelves dilated and infected. This patient died subsequent to transplantation. In another case the final outcome was not fatal, but such a marked rectal fibrosis developed that a regular rectal dilatation became necessary to avoid complete rectal obstruction.

These patients were treated during the early years of the use of supervoltage roentgen therapy when the danger to the deeper structures was not sufficiently appreciated. We have since then learned to avoid these severe reactions and no severe by-effects due to treatment have been observed so far in the cases observed in the last 6 years. It should be particularly pointed out that necrotic ulcers in the bladder which are at times found after treatment of uterine carcinoma have never been observed in roentgen therapy of bladder carcinoma. This indicates that they are most likely due to faulty technique in the radium application in cancers of the cervix rather than

to the external irradiation. In cases of carcinoma of the bladder which are controlled, cystoscopy usually does not show any remnant of the disease or any appreciable trace of the preceding irradiation. In most instances it is impossible for the urologist to recognize the location of the former lesion unless there is some area of atrophy or superficial scarring. In most cases the bladder mucosa appears normal unless the tumor was very extensive.

Rectal reactions of any degree of intensity likewise are not observed when the technique has been carefully controlled. Most of our patients are treated through 3 fields: one central anterior port and two oblique lateral ports centered toward the bladder. In this way the rectum receives its main irradiation through the anterior port only while most of the rectum is spared by the posterior fields. Only very occasionally we have observed even a transitory diarrhea.

We believe that the use of supervoltage roentgen therapy in the treatment of bladder carcinoma has a decisive advantage over the use of the lower voltages. It is possible to administer a tumor sterilizing dose through 3 comparatively small fields. With the lower voltage this tumor dose could be obtained only by a large number of fields because the skin of one single field would not tolerate the amount which it is possible to administer with supervoltage radiation. When the number of fields is increased each single field also must be larger because the aiming toward the bladder from any but the 3 fields mentioned is difficult and in order to include the entire bladder the field has to be fairly large. It thus necessitates a greater volume dose throughout the body quite frequently accompanied by more intense general reaction.

SUMMARY AND CONCLUSIONS

Of 68 patients with advanced carcinoma of the bladder treated between 1934 and 1950 with 800 kilovolt roentgen irradiation 10 are so far clinically well and cystoscopically without evidence of disease. Seven of these are well and have remained well for more than 4 years. The analysis of the successes and failures had led to certain tentative conclusions with regard to indications and contraindications.

tions of this procedure. We wish to emphasize that we do not consider these conclusions final but only a working basis for further investigation.

Contraindications. External roentgen therapy of the type here discussed for carcinoma of the bladder is a formidable procedure. Only patients in good general condition will support such a major procedure. Adequate bladder drainage and capacity and absence of marked infection are prerequisites for a fair trial by this method. Previous suprapubic operation particularly in the presence of any obstruction or infection constitutes an additional hazard to intense irradiation.

It is self-evident therefore that this method is not a procedure suitable for palliative purposes. Cancers inoperable because of extensive extension have not been benefited.

Indications. While increased experience during the last years has shown that our adherence to the contraindications as outlined is justified, we have somewhat modified our position with regard to the indications. The most suitable cases for radical roentgen therapy are the extensive papillary carcinomas in which infiltration cannot be demonstrated. If papillary carcinomas recur after repeated fulguration or if the surgeon feels that a certain type of carcinoma will probably recur after fulguration, roentgen therapy is indicated without further delay if it is considered at all. We mean that one should make up his mind in a particular case whether it should be treated by roentgen therapy or by some other procedure. If roentgen therapy is chosen it should not be requested as a last resort when the conditions for success have become considerably lessened by infiltration, poor general condition or associated infection.

The likelihood of cure by roentgen therapy is less marked in infiltrative growths. While there are some reports in the literature and in our own series substantiating the belief that certain infiltrative carcinomas might still be cured, we believe that the likelihood of control becomes practically nil when the bladder muscle is invaded. We cannot yet determine with certainty whether those patients who have benefited showed an infiltration of the

bladder mucosa only without true infiltration of the bladder wall but from our experience with other carcinomas it is obvious that with progressing infiltration control by roentgen therapy is correspondingly decreased. Carcinomas that have developed beyond the bladder wall and have become palpable by rectal examination are beyond cure. It must be considered that occasionally an infiltration might be apparent which may be due to accompanying inflammatory infiltration rather than true carcinomatous extension. It must also be kept in mind that the histological examination of the removed specimen may be misleading. The biopsy obtained from the periphery of the growth may not demonstrate deeper infiltrative portions of the tumor. A loop resection biopsy adequately done may give more adequate information than a biopsy taken only from the surface of the growth.

We feel therefore that a small carcinoma of a primarily infiltrating type is better handled by surgical excision if this is feasible. If the lesion is so located that a complete bladder resection is the only surgical procedure possible, interstitial irradiation preferably in the form of implantation of removable radium needles is probably superior to roentgen therapy provided the actual size of the tumor is not beyond about 3.5 centimeters in diameter.

With increasing experience we hope better to differentiate these tumors—those which are suitable for roentgen therapy from those which receive more benefit from other procedures. Progress however can be expected only by a careful selection of cases and impartial analysis of successes and failures. This can be accomplished only by close co-operation between urologist and radiotherapist.

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REFLEX SYMPATHETIC DYSTROPHY

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REFLEX sympathetic dystrophy is a most disabling often extremely painful malady following minor sprains ordinary fractures or in military or civil life trauma to blood vessels or nerves. The syndrome is characterized only at times by the excruciating burning pain that has given it the term 'causalgia,' hence a misnomer. Pain may be moderate mild or absent. The true diagnostic features are those disorders initiated by perversions of reflex sympathetic stimulation namely increased rubor or pallor sweating edema, atrophy of skin and spotty or even cystic atrophy of bone.

Mitchell Morehouse and Keen wrote the first brilliant description of this distressful phenomenon based on cases of gunshot wounds to nerves and blood vessels in the Civil War. Sudeck described cases of painful joint involvement giving rise to the term Sudeck's syndrome. Lenche pointed out most vividly the role of the sympathetic system in the pernicious reflex, and Horman, in his presidential address to the Massachusetts Medical Society in 1940 brilliantly described the picture and cure of several cases of minor causalgia. To Livingston in his scholarly monograph entitled *Pain Mechanisms* I would wish to give credit for the clearest theoretical elucidation of the reflex itself. In the diagram and ideas expressed in this article I have borrowed heavily from his theory to explain the vicious circle producing the syndrome of reflex sympathetic dystrophy.

MECHANISM OF REFLEX SYMPATHETIC DYSTROPHY

Figure 1 illustrates diagrammatically the nervous pathways giving rise to the syndrome of reflex sympathetic dystrophy. The fundamental concept of the internuncial pool (Fig. 2) advanced by Lorente de N6 and adopted by Livingston can be explained simply as follows. A prolonged bombardment of pain impulses sets up a vicious circle of

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reflexes spreading through a pool of many neuron connections upward, downward, and even across the spinal cord, and perhaps reaching as high as the thalamus itself. Because of the summation principle of nervous impulses, there is kept alive within such a pool a constant circling of activity across the synapses involved. Some of these synapses include the sympathetic motor neuron cells in the lateral horn controlling vasomotor tone and the sweat glands. Spasm in the arteriolar and venule end of the capillary loops raises filtration pressure and edema and swelling result. Cyanosis and anoxemia increase capillary permeability and filtration further augmenting edema. Other synapses involved may be the anterior motor horn cells, giving rise to skeletal muscle cramps and spasms. Out of the pool also arise augmented stimuli to pain traveling up the thalamic tract. Depending on the wide spread of the pool we detect the phenomena of pain and sympathetic disturbances observed a long distance from the injured area in the limb and occasionally even spread to the contralateral limb. The afferent pathway is represented as the sensory nerve fibers traveling in the posterior root since according to Livingston after careful review of the evidence, pain bearing fibers do not exist in the sympathetic somatic system. Therefore, the abolition of pain by severance of the sympathetic pathway is not due directly to any blocking of afferent pain fibers but to an interruption of the efferent sympathetic pathways leading from the internuncial pool. It must be noted, however, that pain relief is not always complete and further measures must be taken, as noted in the paragraph on treatment.

ETIOLOGY

In the past 3 years I have gathered mainly from the orthopedic service the neurosurgical service and a few from the medical and surgical services of the Lahey Clinic, 33 cases of reflex sympathetic dystrophy. The exciting trauma or diseases are as follows: sprain, 9

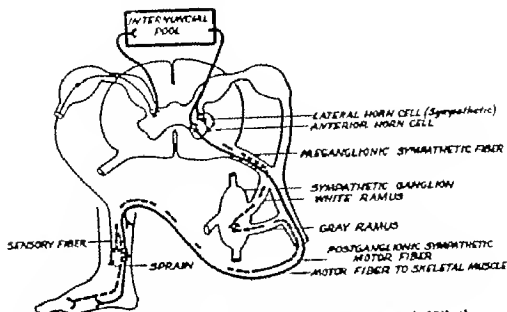


Fig. 1 Reflex arc of sympathetic dystrophy embodying Lorente de No's theory of the "internuncial pool" (Fig. 2)

fracture, 5 thrombophlebitis, 4 poor foot statics, 3, bruise, 2 amputation, 2 scalenus syndrome (?), 2 laceration of hand, 1 anterior poliomyelitis (?), 1, planter wart, 1 gonorrheal arthritis, 1 thalamic syndrome (cerebrovascular accident), 1. In addition there were the complications of fungus infection in 3 and operative interference in 3. Mindful of conceiving of these cases as reflex sympathetic dystrophy and not necessarily causalgia, I have included cases which showed undoubted sympathetic vascular or sweating phenomena and only incidentally pain. This concept has led me to include 4 cases of thrombophlebitis. Injury to blood vessels in the form of arterial injury has been reported before as a cause for causalgia (Homans, Weir Mitchell, and associates). Thrombophlebitis is less often recognized as a possible source of causalgia. In 3 of the 4 cases of thrombophlebitis muscle cramps have been an outstanding feature of the pain. One of these 3 patients had no constant pain but only cramps. One patient with reflex sympathetic dystrophy with a history of 'torn ligaments' in the wrist 10 months before and

operative interference 4 months later had no pain but the sympathetic phenomena of rubor, swelling and hyperhidrosis were present to a marked degree.

Injuries in the form of sprain, fracture, bruise, lacerations and amputations together accounted for 59 per cent of the cases. Three of the patients suffered from poor foot statics; the respective diagnoses being pronated feet, relaxed feet with metatarsalgia, and pes planus.

Two cases of scalenus syndrome (unproved by operation) are included because the scalenus pressure had produced Raynaud's syn-

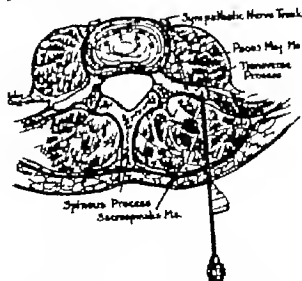


Fig. 3 Technique of paravertebral sympathetic procaine block. (From Nicholson, Anesth. and Analg., May June 1942.)



Fig. 2. Internuncial pool—closed self-re-exciting chain.

TABLE V—RESUME OF 32 CASES

Case Admission Date	Original injury	Pain	Trigger points	Rubber band	Pulse	Swelling	Red- ness	Altruity muscle	Roos	Crimp	Block	Sympathetic
1-30-44	Anterior poliomyelitis at 3	Extremes, 18 yrs. Causalgia.	+	++	+	++	-	-	-	-	Relief	90% improved in 37 mos.
4-16-44	Spindle 9 mos. before	Mild 9 mos.		+	-	+	-	+	(Method)	-	Relief	90% improvement by 3-4 mos. later atrophy
7-1-44	Fracture of metatarsal 4 approx. 100% interval of causalgia	Severe, 6 mos.	+	+	+	-	-	-	(Method)	-	Relief with trigger point gone	3 wks. relief of causalgia but pain persists from causalgia myelitis in ad metatarsal
8-1-44	Pes planus	Moderate, 6 mos.	-	-	-	+	-	-	(Blanchy)	-	100% relief mo. (proper shoes alone)	
8-1-44	Concussion arthralgia 3 yrs. ago by fall from 10 ft. followed by fracture fibula; causalgia type	Swelling over rt. leg and 3 yrs. Causalgia.		+	+	++	-	-	+ surgical excision rt. leg	-		Sympathetic for 3 yrs. particular 100% relief of pain 3 mos. later
8-7-44	Posterior thrombophlebitis 3 yrs. after venogram positive	Moderate, 6 yrs. 1 severe, yrs.	+	-	-	-	-	-	-	-	3 wks. post- operative relief of trigger point	
9-7-44	March fracture of tibia; phle- bitis of thrombophlebitis in ex- posed venogram; causalgia type	Moderate, 9 mos.	+	+	+	+	-	-	-	-	97% relief on 3 blocks remained better of result of surgical trigger point gone	Sympathetic, re- mained better of result of surgical trigger point blocks in not permanent
9-7-44	Leucostoma across rt. heel 37 days later operation on heel	Causalgia severe yrs.	+		+	+	+	+	+	-	No relief	90% relief 3 mos. (sends sends phlebotomy and injections of trigger points)
9-8-44	Plaster cast	Acute, 9 mos. Causalgia.	+	+	+	+	-	-	-	-	Recommended	
10-8-44	Fracture of radius	Severe, yrs.	+	+	+	+	+	+	+	-	Relief	Marked days
6-1-44	Squarish thrombophlebitis in varicose vein	Severe	+	+		+	-	-	-	++	Blocks, 3 (small) 97% relief yrs.	
11-7-44	Fractured foot	Moderate	-	-	-	-	-	-	-	-	Relief 90%	
12-8-44	Refracted nail	Moderate	+	-	+	+	-	+	(Radio- log)	-		9 mos. 5% improvement sends injections of trigger points and phlebotomy
12-8-44	Old thrombophlebitis	-	-	+	-	+	-	-	-	++	Recommended	
9-9-44	Spindle yrs. ago; trigger point	Severe, yrs.	-	+	-	++	+	-	+	-	Relief	mos. 95% improvement
9-12-44	Two hematomas in right 10 mos. one operative; other in mos. ago	-	-	+	-	+	-	-	+	-	Recommended; better by further opera- tion procedure	

drome together with constant pain, relieved by cervical sympathetic procaine block.

In one case a plantar wart gave rise to excruciating pain in the foot associated with rubor and swelling of 9 months duration.

A patient who had had gonorrheal arthritis of the foot 8 years before retained a swollen sore big toe for 8 years. Roentgenogram of the toe demonstrated an aseptic necrosis and physical examination revealed rubor, swelling and hyperhidrosis associated with fungoid ulcers. Severance of the lumbar sympathetics abolished pain and led to healing of the ulcers after abolition of the excessive sweating.

One patient with thalamic syndrome who had hemiparesis following a cerebrovascular accident experienced temporary relief of causalgic pain in her right arm after cervical sympathetic block with procaine. This surprising result might arouse much speculation on the mechanism of so called thalamic pain. Opportunities to repeat this observation are needed.

A single case is reported here of terrific causalgic pain for 25 years that may have followed infantile paralysis at the age of five.

Local operative interference may only exacerbate the reflex sympathetic dystrophy already well established, as occurred in 3 cases. In such cases sympathectomy is advisable before the necessary local surgical procedure is attempted. Fungus complications in the fertile soil created by hyperhidrosis seemed to increase the severity of the symptoms in 3 cases.

PAIN

Pain is usually the most prominent feature in reflex sympathetic dystrophy. It may be one of the most excruciating pains human flesh is heir to: a deep burning agony throughout an entire foot, hand or limb that makes a patient wince as one approaches him with the examining hand; a pain that sometimes makes him contemplate suicide. Trigger points are often multiple and pressure on one often spreads a diffuse pain of a burning peculiar nature up and down the limb. More often in less severe cases the pain response stays definitely localized to the trigger point. In our 32 cases, trigger points, single or multiple were found in 19. Pain was excruciating and of a burning causalgic nature in 5 rated

severe in 12, moderate in 11, mild in 2 and none existed in 2 cases. These last two patients showed other signs of reflex sympathetic dystrophy.

OTHER SYMPTOMS AND SIGNS

Rubor was present in 15 and pallor in 9 cases. The rubor may be so constant and the foot or hand be so hot that the picture of erythromelalgia is produced. Livingston has suggested that rubor is often present in early cases, pallor in the more chronic cases. This has not been my impression in this series. In 6 cases rubor was present and of 2 years' duration or more and in 1 case for as long as 18 years. Swelling or sweating or both was present in over half of the cases. Atrophy of the skin was noted in 4 and of muscle in 7 patients. The typical bone atrophy of sympathetic origin is mottled. In advanced cases even cystic, presumably owing to nutrient artery spasm. Such bone atrophy was described in the roentgenograms of 6 patients in this series. A diffuse osteoporosis resembling that of disuse was noted in 5 cases. Trigger points were noted in 19 cases.

DIAGNOSIS

Either cervical or paralumbar sympathetic procaine block comprises a diagnostic therapeutic test. The relief of pain may be almost miraculous but need not be so dramatic as to establish the diagnosis provided relief of other phenomena is also noted, such as relief of sweating, increased warmth and comfort, a cold member associated with rise of skin temperature (temperature index test) and disappearance of trigger points. Nineteen of our 32 patients had blocks performed with varying amounts of relief in all but one.

TREATMENT

The ideal point of attack would be the international pool itself. So far no direct effective means is at hand to stop the vicious circle within this pool of neuron synapses.

Two other points of attack exist: the trigger points and the sympathetic pathway. Repeated injections of the trigger points usually are necessary. If the sympathetic pathway is blocked by procaine, one is occasionally gratified



Fig. 4.



Fig. 5.



Fig. 6.

Fig. 4. Case 2. Mottled bone atrophy of reflex sympathetic dystrophy (Sudeck's syndrome).

Fig. 5. Case 3. Marked mottled type of bone atrophy.

Fig. 6. Case 5. Gonorrheal arthritis 8 years before ad

mission. No evidence of gonorrheal activity at present. Aseptic necrosis of both phalanges of right great toe, diffuse osteoporosis of distal radius. Condition was cured by splanchnicectomy.

fed by the astounding relief obtained with only one injection. More often there are lapses within a few days or weeks and repeated injections are necessary at longer and longer intervals. It would seem more logical to give a series of three injections one every second day for more permanent rupture of the pernicious reflex, a method so successfully applied to thrombophlebitis (Fig. 3).

At the clinic we have felt it best to resort to sympathectomy in the majority of our treated cases after the demonstration of the efficacy of one block in order to obtain the maximum of relief and the greatest assurance of permanency of relief.

Posterior root rhizotomy, cordotomy or for high cervical segment interruption of the thalamic pathways in the medulla and even resection of the sensory cortex may be necessary in exceptional cases.

Nineteen patients received sympathetic procaine block with varying amounts of relief of pain and sympathetic phenomena in all but one. Nine patients were treated by block alone. Of these 9, 7 had 50 to 100 per cent

relief of pain for 3 weeks to permanent relief. Two of the 9 received only temporary relief for the duration of the procaine effect. Only 1 patient was treated by injection of trigger points as well as by sympathetic procaine block, with relief of pain for only 3 weeks. A sympathectomy is to be done on this patient. Thirteen patients have had sympathectomy with pain relief ranging from 75 to 100 per cent in 9 (69 per cent). Failure to 25 per cent relief resulted in 4 of the 13 cases.

ILLUSTRATIVE CASE REPORTS

CASE 1. A woman aged 30 years came to the clinic November 20, 1913, because of extreme caustalgic type of pain in the right leg for 25 years following an attack of what may have been anterior poliomyelitis at the age of 5 years. There was marked rubor, moderate swelling and marked sweating and several trigger points were present. The pain was so extreme that she had developed a conditioned reflex with the hands breaking out into sweat if one made a motion toward her foot as though to touch it. She took a half hour in the morning to put her shoes on because her right foot was so tender.

Paravertebral sympathetic block afforded marked temporary relief. Sympathectomy was performed.



Fig. 7

Fig. 7. Case 6. Thrombophlebitis of 8 years' duration. Venogram showing no filling of deep venous circulation.

Fig. 8

Fig. 8. Case 7. Callus of old "march fracture"

with 90 per cent relief of pain and 100 per cent relief of rubor swelling and excessive sweating when the patient was seen 1 year and 10 months later. There was still slight tenderness over the trigger points behind the external malleolus below the lateral aspect of the right knee. The patient was most grateful.

CASE 2. A woman came to the clinic February 16, 1944 because of mild pain, rubor swelling and slight muscle atrophy which had been present ever since she sprained her ankle 9 months before admission. The roentgenogram showed mottled bone atrophy (Fig. 4). Paravertebral sympathetic block afforded temporary relief. Sympathectomy was done with 90 per cent relief of pain in 1 month. At this same time a roentgenogram showed less bone atrophy.

CASE 3. A man had sustained a fracture of the second metatarsal followed by operative removal of exostosis 6 months before admission to the clinic, October 8, 1944. For the past 6 months there had been severe pain in the foot. Trigger points, rubor swelling and bone atrophy were present (Fig. 5). Paravertebral sympathetic block afforded relief with disappearance of trigger points. Sympathectomy was done and after 3 weeks there was relief of the causalgic pain. However pain was still persistent in the foot from the osteomyelitis of the second metatarsal. A colored photograph 3 weeks after operation showed definitely less rubor and swelling.

CASE 4. A man came to the clinic August 14, 1944 because of moderate pain in the right foot of 6 months duration. There was definite swelling and a blotchy type of bone atrophy. There was no history of trauma but marked pes planus was present. One month after one paravertebral block, 100 per cent relief of pain was obtained. The patient also had proper shoes fitted.

CASE 5. This man came to the clinic June 13, 1944. He had suffered from gonorrheal arthritis 8 years before admission. There had never been complete subsidence of pain in his right big toe and foot. Hy perhidrosis had been present, complicated by fungus infection, with ulceration. Rubor swelling, and marked sweating were apparent. A roentgenogram showed an aseptic necrosis in the toe (Fig. 6). The patient also had essential hypertension. For this reason a splanchicectomy rather than sympathectomy was done. There was 100 per cent relief of the pain in the right foot and toe. Three months later his foot was dry and the ulcers had healed. A check-up roentgenogram of the toe showed the same aseptic necrosis present.

CASE 6. A woman came to the clinic August 7, 1944. She had suffered postpartum thrombophlebitis 8 years before admission. For the last 6 years there had been moderate pain, which had grown much more severe during the last 3 years. A trigger point was present over the popliteal vessels. A veno-

gram (Fig. 7 a and b) showed failure of deep venous filling in the calf and thigh. A paravertebral sympathetic block afforded 100 per cent relief for 3 weeks following which there was a relapse. It is planned to inject the trigger point and repeat the paravertebral block.

CASE 7. A college girl aged 21 years came to the clinic September 7, 1944. She had suffered moderate pain in the right lower leg following a fall skating 9 months before admission. Marked swelling and rubor developed. For the past 2 months purpuric spots had appeared over the right lower leg. Sweating had become pronounced. Soon after the fall she was confined to bed with what was called the flu. At this time she had fever and red streaks on her leg. A venogram at the time of her hospital entry showed normal filling of the deep calf veins and the femoral vein in the thigh. There was normal capillary fragility in the affected leg. Coagulation time, bleeding time and platelets were normal. A roentgenogram of the tibia revealed the callus of an old "march fracture" (Fig. 8).

This patient was treated with a series of three paravertebral sympathetic procaine blocks in 1 week. At the end of the week the swelling had subsided and the trigger points had disappeared. She was seen 3 months later and pain was completely relieved.

CASE 8. A woman had sustained a laceration on the dorsum of the right hand a year before being seen at the clinic, September 7, 1944. Two operations had been performed on the hand in the hope of relieving severe causalgic pain of a year's duration. Trigger points, pallor, sweating and muscle atrophy were present. Roentgenograms demonstrated diffuse bone atrophy. Paravertebral block afforded no relief. Nevertheless sympathectomy was done, with 50 per cent relief of pain 3 months later. This patient needs much physical therapy which it is now possible to give because the limb is so much less tender to manipulation. Injections of trigger points are advised.

CASE 9. A man came to the clinic, June 28, 1944 because of a plantar wart with excruciating pain through the foot for 9 months. A trigger point was present over the wart. Rubor and swelling of the foot were noted. Paravertebral sympathetic block was recommended but refused.

SUMMARY

Reflex sympathetic dystrophy is described as a syndrome produced often by minor trauma or disease in a limb leading to the reflex production of the sympathetic phenomena of rubor or pallor, heat or cold, increased sweating, edema and pain. Since the factor of pain

may be absent, the term reflex sympathetic dystrophy is preferred to causalgia.

The rôle of Lorente de Nó's "internuncial pool" in the production of the syndrome of reflex sympathetic dystrophy is presented.

Traumatic injury accounted for only 59 per cent of the 32 cases reported.

The typical bone atrophy of reflex sympathetic dystrophy is mottled or cystic (Sudeck's syndrome).

Diagnosis depends largely on the demonstration of relief by sympathetic procaine block. Nineteen of the 32 patients received sympathetic block with procaine, with varying amounts of relief of pain and sympathetic phenomena in all but 1 patient.

Treatment may be directed to blocking the trigger points if they exist and to blocking the sympathetic pathway. In 9 patients treated by sympathetic procaine block alone, 7 had relief of pain varying from 3 weeks to permanent; such pain relief estimated at 50 to 100 per cent. The other 2 received relief of pain only for the duration of the procaine effect.

Thirteen patients of the 32 here reported had sympathectomy performed with relief of pain ranging from 75 to 100 per cent in 9 or 69 per cent. Failure to 25 per cent relief of pain resulted in 4 of the 13. The 2 patients who had no pain but other sympathetic phenomena have so far not submitted to either block or sympathectomy.

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A SINGLE STAGE OPERATIVE METHOD OF MANAGEMENT OF CHRONICALLY INFECTED UNUNITED FRACTURES

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COMPOUND fractures of the long bones are seen relatively frequently among war casualties particularly favored for this injury are both bones of the leg. Unfortunately a rather high percentage of these cases become infected and later present the picture of chronic osteomyelitis or soft tissue infection and nonunion. Review of statistics reveals that there has been an increase in the incidence of faulty union during this war seen in both simple and compound cases in spite of the use of the sulfonamides and penicillin. In a good number of cases treatment was delayed by transport difficulties others were wounded previous to routine use of the drugs.

In the far past, because of a long line of unhappy experiences a markedly conservative restriction was placed upon surgical interference in cases with infection. Operation was mentioned only to be condemned. Recently since the advent of the chemotherapeutic agents which render the infecting organisms avirulent practice has been to administer preliminary supportive and specific therapy then at operation to excise the infected tissues as thoroughly as possible and secure drainage. After subsidence of the infection a grafting operation is performed. This accepted procedure has been and still is for certain cases the one practiced here. However a number of protracted convalescent periods while cure of the infected area was awaited and one case of relighting of a latent infection some months after bone grafting caused a different procedure to be adopted with a certain type of patient.

Particular concern was shown over cases with marked loss of bone substance and ones with lengthy infection. In these instances in view of the extensive fibrosis of soft tissues

with marked sclerosis and atrophy of the main fragment ends, it seemed that the preliminary operation for excision and drainage could not possibly remove all the factors of latent infection to prepare for grafting. The length of convalescence before rehabilitation could begin was not in the best interest of the patient's mental outlook and general health equally important. It endangered the preservation of function of the limb involved. This latter factor was of most serious import, as the prolonged immobilization would lead to irreparable contracture and fibrosis of the musculature and periarticular structures, resulting in partial or complete permanent disability of the limbs. A resultant united fracture in a limb with stiff or painful joints would leave much to be desired. In patients with long standing osteomyelitis and moderate-sized bony defects, we believed that a departure from previous practice might be made before amputation was considered.

A group of patients was chosen for more radical procedure. Eleven cases with long bone involvement are illustrated below similar circumstances have been successfully treated in small bones. The patients were adults in the various armed services who received compound fractures in the line of duty with subsequent infection. All infections were in the quiescent state when treatment was begun. Some patients revealed frank osteomyelitis while others suffered from chronic infection of soft tissues, with or without dispersed small bone fragments. Most of the patients showed a flail-type of nonunion plainly evident at physical examination. The technique of the single-stage procedure upon leg cases, consisting simply of a radical osteotomy and excision of infected soft tissue with internal fixation by plating will be given in outline to avoid repetition.

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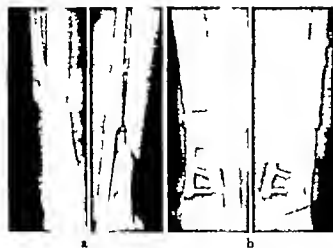
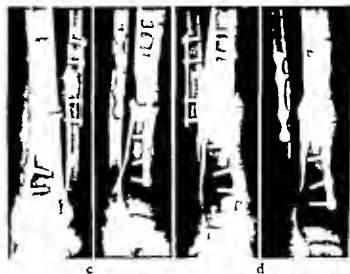


Fig 1 Case 1 a, Preoperative views b 1 day post operative c, 8 weeks postoperative showing the usual



absorption and bone regeneration d 1 year post operative.

PRELIMINARY PROCEDURE

1 Roentgenological investigation is made of the involved bones and adjacent joints. Sinuses are injected with radio-opaque material to determine recesses location of foreign material and such conditions

2 General condition is investigated thoroughly and an intensive therapeutic period is instituted with bed rest this includes frequent whole blood and plasma transfusions high protein and vitamin intake (vitamin C is stressed)

3 Sulfathiazole is given orally to maintain a blood level of 5 milligrams per cent

4 In several instances dictated by investigation other medication such as thyroid extract, is instituted

5 Mild physiotherapy in form of gentle massage and movement is applied to the adjacent muscles and joints. No specific treatment of the local condition is adopted other than adequate splinting and the usual cleansing of sinus regions by shaving compresses, or dry dressings. For 12 hours previous to operation alcohol dressings are applied

The length of this treatment depends upon the degree of general depletion of each patient and the local skin condition in most instances the skin is severely crusted and granular from lengthy closed plaster therapy

OPERATION

After skin preparation of the whole limb a generous longitudinal incision allowing wide

exposure without tension on the skin is made. The incision includes encircling of sinus openings and is placed 2 inches medial or lateral to the anterior tibial crest. The incision is deepened to expose the tibial periosteum. If possible without sacrifice of the closure all skin scar is excised at this time. However at times the excision of noninfected skin scar is delayed for a future plastic operation. Pains are taken not to traumatize the skin edges. Sinus tracts and all devitalized tissues are excised completely. Loose bony fragments are removed but fragments which are deeply embedded, far from the fracture site and which have no apparent connecting tract are not disturbed. The tibial periosteum over healthy bone is split and reflected about the whole circumference in most instances it is absent or replaced by scar over the infected region. After the tibia has been separated from its bed the two main fragments are usually separated transversely by scalpel. At times the central block of eburnated bone and infected granulation tissue are removed *en masse* by saw but in the majority of cases to allow resection of the bone at the proper levels, the former measure has to be taken. The amount of the main fragments to be removed is more or less predetermined by x ray evidence of the extent and degree of bone sclerosis. The ends of the bones are sawed squarely across to expose freely bleeding marrow canals circumscribed by healthy cortex free of infected granulations. No heed is



Fig. 2. Case 2. a, Preoperative views, b, 3 months postoperative, c, 5 months postoperative, d, 7 months postoperative.

paid at this time to length conservation the minimal requirement is that the segments to be approximated be viable. With such an increased exposure the soft tissue bed of the fracture site, consisting of dense scar interspersed by small pockets of granulation tissue are thoroughly excised care being taken to preserve main arterial and nerve trunks. It is then necessary similarly to expose the fibular fracture site through separate or the same incision and accord it the treatment described. If the fibula has not been fractured, or more commonly if it has healed without infection an equal length of its shaft is excised by saw occasionally it is cut across obliquely to allow its fragments to override without removal of a portion. If the tibia is markedly porotic, the fibula is transected low down so that the superior fragment crosses the tibial fracture to be incorporated in that bone for added strength. The main tibial fragments are then accurately approximated in proper alignment and maintained so by an 8-screw vitalium plate. The plate is applied to the anterior surface of the tibia opposite to the incision site e.g. if the incision is necessarily anteromedial the plate is fixated to the anterolateral tibial surface. (As in fresh-fracture plating certain principles are helpful (a) the plates used are long (b) the screws are

placed eccentrically for added purchase, (c) the screws penetrate the opposite cortex, (d) if wire is used it is of the same metal). The wound is then thoroughly irrigated with normal saline and dusted with sulfathiazole powder. The skin and subcutaneous flaps are closed if possible in a single layer of silk mattress sutures no catgut is buried. If much skin has been lost the closure is difficult or impossible even after wide undercutting of the flaps. In the event of incomplete closure the edges are approximated as well as possible and vaseline dressings are applied without any form of skin-grafting. A moderate pressure dressing with cotton waste follows. The limb is enclosed in plaster from upper thigh to toes with ankle at right angles and knee in 10 degrees flexion. A long window is cut over the incision but it is left unopened.

These principles of technique are similar in the thigh and upper limb fractures, differing only in size of plate, and approach. Spinal anesthesia is used for all lower limb cases cyclopropane and oxygen are chosen for those of the upper limb. All patients receive whole blood or plasma transfusion during operation.

POSTOPERATIVE

The preoperative regimen outlined is resumed. In most instances the sulfonamides

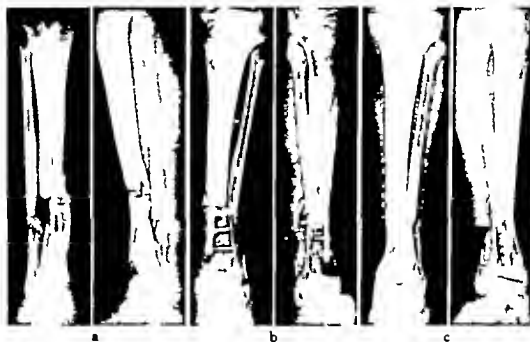


Fig. 3 Case 3 a, Preoperative views, b immediate postoperative views. Note that the screws could not be used in lower fragment due to marked osteoporosis. c, Twelve months postoperative. Plate was previously removed at tendinoplasty

are discontinued in the second week. The wound is inspected on the sixth day through the window and if there is any sign of infection several central sutures are removed and warm saline compresses are applied. Otherwise, all sutures are removed on the ninth day. A walking plaster cast extending from the knee is applied in 5 to 6 weeks and remains present until end of third month.

ILLUSTRATIVE CASES

CASE 1. An infantryman received an explosion wound and was operated upon here 17 months following trauma. Examination revealed a compound fracture of both bones of leg with skin defect and discharging sinus from nonunion infected tibial fracture. The fibula was partially healed by fibrosis. Following operation, the wound healed completely. The use of walking caliper splints was begun in sixth postoperative week. Patient was walking without any support 12 weeks postoperatively with moderate evening ankle swelling. There were no signs or symptoms for 3 years postoperatively. Total limb shortening was $1\frac{3}{4}$ inches (Fig. 1).

CASE 2. Patient was injured in a plane crash, and was operated upon here 11 months following original surgery. He also suffered fracture of other leg and skull. Examination revealed compound fracture of both bones with nonunion, very profuse purulent discharge with skin defect and projecting bone plate, osteomyelitis of tibial fragments only. Following operation, slight serous discharge continued only 10 days through the skin defect. Wound

was completely healed in 4 weeks. Walking by caliper splints was begun in fifth postoperative week. Patient was walking very freely without support by twelfth postoperative week. He was accepted for duty in Merchant Navy 8 months after operation. He had no complaints 2 years after operation. Total shortening of limb was 1 inch (Fig. 2).

CASE 3. Patient was injured in a mortar explosion. He was operated upon here 14 months following wound. Examination revealed a compound fracture of both bones with nonunion, chronic osteomyelitis and sequestration at both tibia and fibula fracture sites, tibialis anticus and extensors all destroyed, moderate skin defect. There was a moderate amount of purulent discharge from the wound. After operation the wound healed completely. Walking by caliper splints was begun 6 weeks after operation. Patient was walking with no support to leg but foot straps in 15 weeks. There was no evidence of infection, etc. 2 years following operation. Function was restored by tendinoplasty. Total shortening was $1\frac{3}{4}$ inches (Fig. 3).

CASE 4. Patient was injured in a plane crash. He also sustained fracture of pelvis and hip dislocation. He was operated upon here 3 months following trauma. Examination revealed a compound fracture of the tibia with grossly infected fragment ends, fibular fracture not infected. There was no sign of attempt at union and a discharging skin sinus was present. The wound healed after operation by primary intention. Walking by caliper splints was begun in 8 weeks. Its application was delayed by other fractures. Walking without support was possible in sixteenth week and he was returned to duty. Total shortening $\frac{3}{4}$ of an inch. No disability for past 2 years (Fig. 4).



Fig. 4. Case 4. a, Preoperative view; b, Immediate postoperative view —note lower leg fractures also; c, 6 months postoperative.

CASE 5 Patient was injured in a motor accident. One sequestrectomy had been performed. He was operated upon here 6 months later for flail limb with discharging sinus. Examination revealed nonunion with chronic infection of tibia and sequestration. Osteotomy of both bones was performed. The wounds healed without complication. Walking cast was applied in 5 weeks; he was walking without support 3 months after operation. Total shortening was 1 inch. Elective removal of plate 2 years later revealed perfect union without evidence of infection. Full duty performed during the past 2 years without symptoms (Fig 5).

CASE 6 Patient was injured in a plane crash and suffered compound fracture of both bones with ulcerated discharging wound and flail-limb. Operation was performed here 5 months following accident. Examination revealed nonunion with sequestra and

small loculations of pus about the tibial fragment. The lower fragment was markedly osteoporotic. Following the osteotomy, the upper fibular fracture was placed across the tibial fracture. The wound healed completely. A walking cast was applied in fifth week and all splinting was removed after 3 months. Patient was on full flying-duty 7 months after operation. Total shortening was 1 inch. Plate was removed for inspection 1 year later; no residual infection was evident. He has had no complaints for past 2 years. (Fig 6).

CASE 7 This case is presented for comparison. Patient was injured in a motor crash. He also suffered a fractured spine. He had had a series of previous sequestrectomy operations. Operation was performed here 2 years following injury. The findings were compound nonunion flail-fracture of tibia with osteomyelitis and sequestration; fibular



Fig. 5. Case 5. a, Preoperative; b, 1 month postoperative; c, 1 year postoperative.

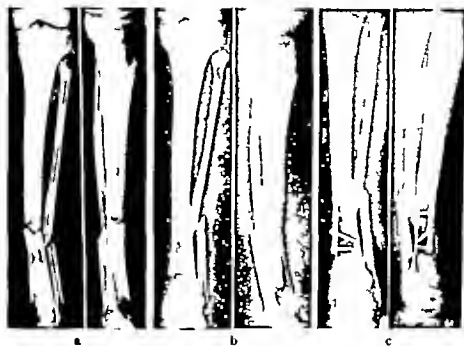


Fig 6 Case 6 a, Preoperative views b 5 weeks postoperative c, 1 year postoperative.

fragments partially united and not infected. Also profuse discharge through multiple skin sinuses. In this case the usual osteotomy was not performed due to extensive sclerosis of large intermediate tibial fragment. The necrosed bone and infected soft tissues were thoroughly excised plate was applied for stability. The wound healed primarily one month postoperative a single small sinus formed and intermittently recurred for 1½ years but discharged only spots of thin serum. Bone union progressed slowly. Patient walked without support in twelfth postoperative week. No shortening. Plate removed recently and bone was seen to be healed securely.

CASE 8 Patient was injured in a plane crash. He suffered compound fractures of both femora. Both bones were plated. The right femur united firmly with marked lateral bowing. The left femur was infected and nonunited. He was operated upon here 8½ months later. The findings were flail limb with gross infection of fragments sequestration, and discharging sinuses. Considerable pus and marked loss of bone substance were noted. bone plate was very loose. The plate was removed and an osteotomy and plating were performed wires were also used because of marked osteoporosis. Patient refused splin and only posterior thigh mold was used. The wound discharged small amount of thin pus for

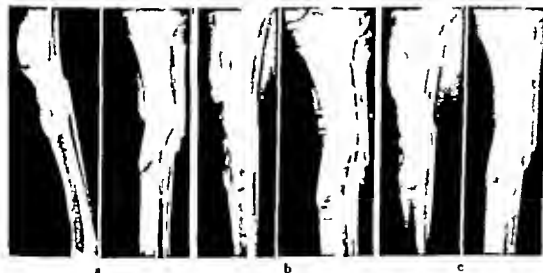


Fig 7 Case a, Preoperative view b, Two months postoperative c, Six months postoperative



Fig. 8. Case 8. a, Preoperative view b, 5½ months after operation. No evidence of infection about the screws. Usual changes for this period at osteotomy site.

3 weeks then healed completely. An ischium-bearing walking caliper with crutches was allowed 6 months after operation. Patient refused further plastic bone repair and was transferred. When re-examined 1 year later he was walking with a cane but no recurrence of infection was evident. Limb shortening was not significant as the opposite femoral bowing compensated (Fig 8.)

CASE 9. Patient was injured in a motorcycle accident. He received a compound fracture of the middle third and simple fracture of metaphysis of left femur. The upper fracture failed to unite the

lower one healed. Operation was performed 9 months after accident. The findings were No discharging sinuses were noted but sequestra and burrowing pus pockets about fragment. Plate was placed anteriorly away from skin incision. The wound healed completely. Posterior body leg cast was maintained 2 months. A walking caliper splint was applied at 3 months and patient was able to return to college. The plate was removed for inspection 11 months later. He has had no complaint for past 16 months. Total shortening was 1¾ inches. (Fig 9.)

CASE 10. Patient was injured in a motor accident. Two subsequent sequestrectomy operations had been performed. He was operated upon here 5 months following accident. The findings were compound fractures of both bones with distal radial fragment extruding and chronic infection of fragments of radius and of soft tissues. Flail limb. After osteotomy of radius and excision of infected granulations, the ulna was shortened through a separate incision. Following operation, the wound healed completely. The cast was removed after 6 weeks. Total shortening was ¾ of an inch. Functional return was complete. He has had no disabilities for past 12 months. Patient returned to duty as coal stoker (Fig 10.)

CASE 11. Patient was injured in a motor crash. Compound fractures had been openly reduced. He was operated upon here 4 months after accident. The findings were Compound fractures of both bones of forearm with flail nonunion. Chronic infection of fragment ends with small sequestra and wire through ulna sinus over dorsum of ulna. Following operation the wounds healed completely. Splinting was substituted by sling in 4 weeks. All movements were complete. Plates were removed 4 months after operation without signs of infection.

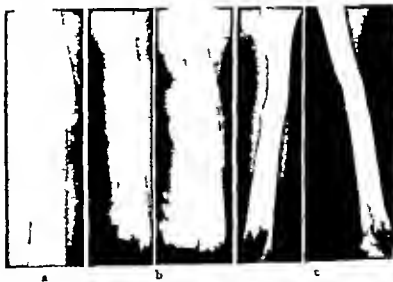


Fig. 9. Case 9. a, Preoperative views b, 1 day postoperative c, 11 months postoperative



Fig 10. Case 10. a, Preoperative views b Two and one half months postoperative c, One year postoperative.

Three years have passed without disability. Total shortening was $\frac{3}{4}$ of an inch (Fig 11)

OBSERVATIONS

This is not an established method of treatment and will undoubtedly be the subject of considerable diversion of opinion. Although exceptionally good fortune attended the patients, precisely the same sequence of events was noted in the clinical and x ray progress toward secure union without undesirable sequelae in no instance has there been oc-

casión to regret the procedure. It did not seem that a lack of bone-forming capacity existed once the grossly infected sequestra and soft tissues had been removed and vascular bone fragments were properly immobilized in apposition.

Without embarking upon discussion as to the etiological factor in the nonunion in these cases beyond the common one infection histories indicated that interrupted skeletal traction had most commonly occurred. In adequate fixation which is the expected

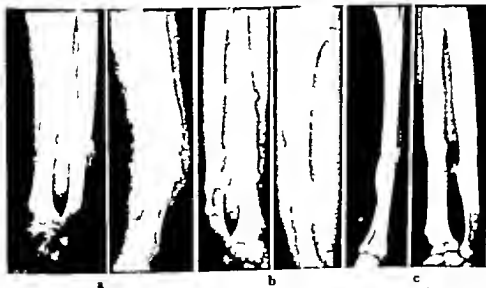


Fig 11. Case 11. a, Preoperative views b, Three months postoperative c Six months postoperative

accompaniment of mobile war plus a low vitamin C intake were strikingly constant.

While for the most part the ages of the patients were below 35 years, others represented the fourth and fifth decades.

The infection unlike blood borne osteomyelitis, was limited to the fragment ends and to surrounding soft tissues containing smaller loose bone and therefore afforded opportunity for excision. The marked bony eburnation and surrounding avascular fibrosis inhibited elimination of infection solely by chemotherapeutic measures. Organisms were mixed with staphylococci predominating accompanied by streptococci saprophytic organisms, *Bacillus pyocyaneus*, and rarely *Bacillus coli*.

In no instance was there evidence of post operative dissemination of the infective organisms, or a tendency toward local spread.

Importance of local or general administration of chemotherapy must not be overstressed in several of the most grossly infected cases use of drugs was omitted totally because of previously determined allergy.

There have been no residual sinuses or other unfavorable sequelae in those cases in which the full procedure could be performed. Case 7 is given as example of failure to eliminate completely infection in an instance in which an extensive osteotomy could not be done. Osteogenesis was very slow and the bone spanning the infected area appeared sclerosed and brittle. The plate remained firm and maintained immobility during the lengthy healing period. Case 8 primarily very grossly infected eliminated the infection very quickly and united in spite of small surfaces of bone apposed. In this instance the procedure quickly afforded the abandonment of skeletal traction and eliminated the external reinfection of the wound. This latter factor is considered to be an important accomplishment of this procedure.

Postoperative pain was noted by its absence.

From x ray and later operative examination there is reason to believe that the enclosed metal does not form a formidable nidus for bacterial growth. Alarm that plates maintain the fragment ends in dis-

traction during the early physiological period of resorption resulting in non union is not justified by serial roentgenograms in the cases reported here given time firm union occurred. While the plates merely act as splints they can be credited with allowing security over the increased fragility period of bone healing and they allow considerably earlier movement of adjacent joints. (Particularly the ankle and foot.)

Several plates were removed to allow examination of the local area to verify complete absence of latent infection. The screw holes did not fail to heal. Operation for plate removal in these cases is deemed unnecessary.

It will be noted that some bone loss occurred at the original injury the operation further subtracted from the limb but the average total loss in length was 1 inch and did not exceed $1\frac{3}{4}$ inches. It must be remembered that a certain amount of length loss is also an accompaniment of a simple bone grafting procedure in such cases, if the sclerosed bone ends are carefully resected. The shortening in this small series was compensated by the wearing of shoe-lifts which proved to be comfortable and non-disabling. The lower limb cases have been free of complaints, and follow up observation of their backs and pelvis fails to elicit distortion of normal alignment.

SUMMARY

1 A single stage operative method of management of chronically infected fractures with nonunion is considered.

2 The procedure which is performed during the quiescent stage, consists of an exacting excision of infected tissues to create a new vascular bed followed by plate fixation for immobilization.

3 The progress of bone and soft tissue healing is favorably comparable to fresh fracture healing.

4 Cessation of local infection and absence of dissemination are noted the factor of latent infection is negligible.

5 The limb shortening is minimal and is compatible with normal activity and comfort.

6 The procedure hastens local and general rehabilitation and helps patients morale.

THE SAPHENOUS VENOUS TRIBUTARIES AND RELATED STRUCTURES IN RELATION TO THE TECHNIQUE OF HIGH LIGATION

Based chiefly upon a study of 550 anatomical dissections

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RECENT medical literature contains many articles on the treatment of varicosities of the veins of the lower extremity. However little has been written about the tributaries of the upper portion of the great saphenous vein or about related fascial structures. Since attention is necessarily focused upon this area in the treatment of varicosities, knowledge of the commoner types of venous patterns and of variations in form and size of the fossa ovalis should be of service to the surgeon.

The present account deals with vascular varieties to include the following superficial veins: iliac circumflex, external pudendal, epigastric, lateral and medial accessory saphenous veins. In addition the observations have to do with the fossa ovalis and its contained femoral vessels, with the overlying and surrounding fascial layers and with some recommended features of surgical technique which are in the main based upon the anatomical aspects of the study.

MATERIAL AND METHODS

All anatomical observations were made on dissection room specimens (American whites and negroes, preponderantly male). The observations on fascial layers were made concurrently with those on the blood vessels, covering 350 consecutive body halves. The statements on form and size of the fossa ovalis and on the relations of the femoral vessels are taken from an earlier investigation covering 200 consecutive lower extremities (Anson and McVay, 1938); those on structure of the femoral sheath are based upon a study of the

anatomy of femoral hernia (in preparation, Anson, Ashley, Reimann and Beaton).

A sketch of the subcutaneous veins of the inguino-femoral region in each of the 350 thighs was prepared. Accessory venous tributaries entering the great saphenous vein more than 6 centimeters below the junction with the femoral were not considered. In selecting the anatomic types of venous convergence upon the main saphenous vessel, those records represented the specimens types therefore were not selected early in the study from a limited group and then set up as categories into which later cases were fitted.

The illustrations in Figure 2 are diagrammatic, the distance between tributaries and the caliber of the latter being arbitrary. Those in Figures 1, 3 and 4 represent actual specimens. The illustrations in Figure 5 are based upon e and g of Figure 3; ligatures are placed at points which, in the experience of the senior author, would have been selected in actual surgery of the case.

OBSERVATIONS AND DISCUSSION

1. ANATOMY

The anatomical material will be presented in the order in which the sets of layers or groups of vessels are encountered in dissection: first will be considered the superficial fascia, next the superficial veins, finally the deep fascia with its fossa ovalis and the contained femoral vessels.

a. Superficial fascia. Over the proximal third of the thigh, in the area of the femoral triangle, the superficial fascia is two-layered, just as it regularly is in the adjacent inguinal and perineal regions (McVay and Anson, 1938 and 1940). The outer superficial layer

Contribution No. 435, from the Anatomical Laboratory, Northwestern University Medical School.

TABLE I

Type	Right	Left	Bilateral	Per Cent
I	28	24	5	24.66
II	3			3.4
III	3			3
IV				6.00
V	3	4	3	7.7
VI	60	57	9	33.43
VII		3		1.00
VIII	9	8	5	7.71
Totals	80	70		

of the bilaminar superficial fascia is a fatty stratum, while the inner deep layer is fibrous the latter contributes to the formation of a strong membranous investment for the larger vessels of the thigh. It is rather readily separable from the outer adipose layer (Fig. 1 a and b). In addition to the superficial veins the subinguinal and inguinal lymph glands are situated in this deep membranous stratum which, in the femoral triangle some times contains an appreciable deposit of fat. When followed into the fossa ovalis, and therefrom proximalward under the inguinal ligament, the fibrous lamina is found to become the femoral sheath (Fig. 1 c and d). At the inguinal ligament it is continuous with the plate of non fatty tissue which houses the iliac vessels and with the fascial coverings of the abdominal aponeuroses.

In this way the femoral vessels are protected as they lie within the fossa below the level of the falciform margin the saphenous and its tributaries are nearer the skin, yet course along the fascia lata where they are lodged in the fibrous layer of superficial fascia and covered by the fatty stratum.

b *Superficial veins* Before presenting original observations on the saphenous tributaries, it will be helpful to review briefly the standard descriptions of these channels.

The superficial circumflex iliac vein is regularly described as a small but quite constant, vessel which drains the area superior to the lateral half of the inguinal ligament and as far lateralward as the anterior superior spine of the ilium. It is said to be only occasionally duplicated. The vein courses inferomedially

crossing the inguinal ligament obliquely en route to the fossa ovalis, where it may terminate in the great saphenous the femoral the superficial epigastric, or the lateral accessory saphenous vein.

The superficial epigastric vein is likewise small. Arising in the umbilical region some times through anastomosis with the thoraco-epigastric vein the vessel courses inferolaterally over the medial half of the inguinal ligament to the fossa ovalis. Here it empties into the saphenous vein into any one of the latter's tributaries, or into the femoral directly. It may anastomose across the linea alba, with the companion vessel of the opposite side or may communicate with the dorsal penile vein.

The external pudendal is a continuation of the anterior scrotal or labial veins. It commonly receives communications from dorsal penile or clitoral vein and from vessels of the hypogastric region. At the fossa ovalis the pudendal may empty into the great saphenous vein or the femoral or any near tributary (superficial epigastric or accessory saphenous).

Exceeding the above mentioned vessels in size, is a vein which is sometimes termed lateral accessory saphenous. This vessel quite constant in occurrence originates in a suprapatellar network gathering branches from the anterior and lateral surfaces of the thigh. It inclines medially in ascending to the fossa ovalis, where it is likely to empty into the superficial circumflex iliac vein or into the great saphenous vein.¹

The medial accessory saphenous vein is by far the least constant of the proximal femoral group. It drains the posteromedial surface of the thigh and is directed anterosuperiorly to terminate in the great saphenous vein. When such an accessory vessel ascends into the proximal one-fifth of the thigh it usually receives the external pudendal vein near its terminus.²

¹This vessel has been previously described by numerous investigators under the names of external superficial femoral vein (Pernst), lateral superficial femoral vein and lateral femoral circumflex vein (Cunningham), accessory saphenous vein (Tandler), and anterior saphenous vein (Parker and Cherry).

²In the BNA terminology this vein is merely termed the accessory saphenous vein, however the additional designation, medial, must be given to distinguish it from the accessory vessel of the opposite aspect of the thigh. Other terms designating this vessel are lateral femoral cutaneous vein (Tandler), medial superficial femoral vein, medial circumflex femoral vein (Cunningham), posterior saphenous vein (Parker and Cherry).

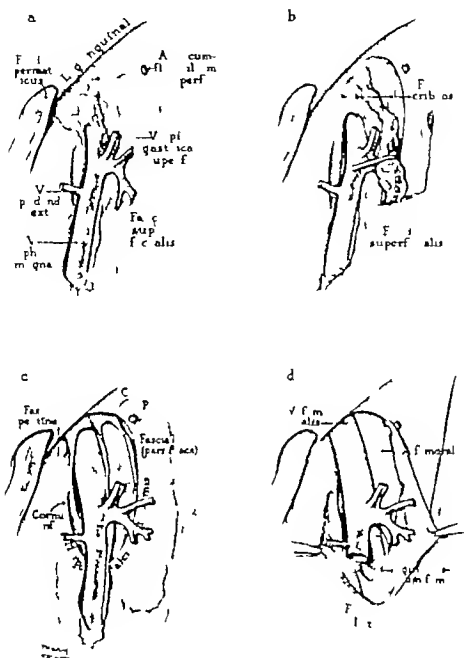


Fig. 1. Investments of saphenous and femoral veins, successive stages of dissection from superficial fascia (a and b) to fascia lata and femoral sheath (c and d). In Figure 1a, fatty layer of superficial fascia has been removed at fossa ovalis to expose membranous layer where it ensheathes saphenous vein. Figure 1b, fatty layer reflected from area lateral to fossa to show falciform margin and superior cornu. adipose layer is perforated by saphenous tributaries to form fascia cribrosa, and is continuous with similar tissue in depths of fossa. Figure 1c, fatty layer entirely removed to demonstrate manner in which immediately subjacent deep layer of fascia forms a complete sheath (here opened) for femoral vessels. Figure 1d sheath further exposed by cutting it beneath incised distal edge of falciform margin.

While such descriptions account for common anatomical features they leave unrecorded some important details of morphology and incidence of common departures from the anatomic normal. These data will now be presented from the authors' observations.

The patterns formed by the five major tributaries of the proximal part of the great saphenous vein are numerous. There is, however, a marked tendency for two or more of these vessels to fuse into a common venous trunk before entering the great saphenous vein.

TABLE I

Type	Right	Left	Bilateral	Per Cen
I	28	24	5	86
II	3			2.24
III	3			2.24
IV	10			6.00
V	3	14	3	7.7
VI	60	57		23.43
VII		3		0.00
VIII		8	3	7.7
Total	80	70		

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In this way the femoral vessels are protected as they lie within the fossa below the level of the falciform margin the saphenous and its tributaries are nearer the skin yet course along the fascia lata where they are lodged in the fibrous layer of superficial fascia and covered by the fatty atrium.

b *Superficial veins* Before presenting original observations on the saphenous tributaries it will be helpful to review briefly the standard descriptions of these channels.

The superficial circumflex iliac vein is regularly described as a small but quite constant vessel which drains the area superior to the lateral half of the inguinal ligament and as far lateralward as the anterior superior spine of the ilium. It is said to be only occasionally duplicated. The vein courses inferomedially

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¹This vessel has been previously described by numerous investigators under the names of external suprapatellar femoral vein (Parroty), lateral superficial femoral vein and lateral femoral circumflex vein (Cunningham), accessory saphenous vein (Fauder), and anterior saphenous vein (Fauder and Cherry).

²In the BNA terminology this vein is merely termed the accessory saphenous vein, however the additional designation, medial, seems to be quite in-discriminate if from the accessory vessel of the opposite aspect of the thigh. Other terms designating this vessel are internal femoral circumflex vein (Tobin), medial superficial femoral vein, medial circumflex femoral vein (Cunningham), posterior saphenous vein (Parroty and Cherry).

saphenous veins, are confluent (Fig 2c), the incidence of this arrangement is 13.1 per cent (46 cases, 25 right, 21 left, 2 bilateral)

In type IV the two regular medial veins namely, superficial epigastric and superficial external pudendal veins, fuse before entering the great saphenous vein (Fig 2d), incidence 6 per cent (21 cases 10 right, 11 left, 2 bilateral). This vascular pattern occurs frequently in association with fusion of the two lateral branches (superficial circumflex iliac and lateral accessory saphenous veins) the combination is catalogued as type VIII.

Type V includes cases in which an accessory medial saphenous empties in common with the external pudendal vein into the great saphenous vein (Fig 2c) incidence 7.7 per cent, (27 cases 13 right, 14 left 3 bilateral). In a few instances the medial accessory vessel is present with one or the other of the remaining types, but so rarely that elevation to the status of a separate type is not warranted. A lateral accessory saphenous vein only rarely accompanies a medial accessory saphenous (2 in the 27 cases). This would suggest that when a medial accessory vessel is present, the lower femoral tributaries of the great saphenous vein drain the region usually cared for by the lateral accessory vessel.¹

Specimens designated as type VI are characterized by a fusion of the three lateral tributaries, namely the epigastric, circumflex iliac, and lateral accessory saphenous the single vein thus formed drains into the great saphenous. This pattern is, by far the commonest encountered in the current study (Fig 2f) incidence 33.4 per cent (117 cases, 60 right, 57 left, 19 bilateral).

In specimens of type VII an unusual plan of fusion occurs the superficial epigastric and the lateral accessory saphenous veins join over the fossa ovalis to terminate by a common stem in the great saphenous vein while the circumflex iliac vein and pudendal veins end independently in the main venous trunk (Fig 2g) incidence, 2.0 per cent (7 specimens 4 right, 3 left, none bilateral).

In type VIII dual fusion takes place the circumflex iliac and lateral accessory saphenous

veins on the one side and the external pudendal and epigastric veins on the other form lateral and medial common tributaries respectively (Fig 2h) incidence 7.7 per cent, (27 cases 9 right, 18 left, 5 bilateral).

Viewing the specimens as a group, some additional facts are evident. The tributary most frequently duplicated is the external pudendal vein (54 instances in 350 thighs) however, triplication is rare (2 cases). The next most frequent duplication is that of the superficial circumflex iliac vein which occurs in 4.8 per cent of thighs (17 cases) in over half of these the supernumerary vessel empties into the femoral vein directly. The circumflex iliac is tripled in but one instance. Termination as a single vessel in the femoral vein occurs in 1.7 per cent of specimens (6 cases). The superficial epigastric vein is frequently doubled the arrangement occurs in only 3.1 per cent (11 cases) it is never tripled and is absent in only 1.4 per cent (5 cases). The lateral accessory saphenous vein is duplicated in approximately the same number of cases (10) never present in triplicate.²

The actual specimens, upon which the diagrammatic figures (Fig 2a to 2h) are based present some details of form which require special consideration. Small veins from nearby lymphatic glands are common (at asterisks Fig 3). Not infrequently tributaries enter the saphenous through a bay like 'trunk' as an intermediary (Fig 3a) so that the confluence may be regarded as formed by two tributaries (type II) or by three (type VI). In the present study vessels were considered to empty separately if their common trunk measured less than 2 millimeters in length. Transformation readily occurs when the 'bay' is widened (type I into type VI Fig 2i). Surgically the distinction is unim-

¹The division made by Fowler and Cherry of the superficial epigastric vein into 'satellite' veins (which anastomose directly with the small artery of the same name) and 'accessory' veins (the associated with the external pudendal vein) was investigated. Employing as criterion simply the simultaneous occurrence of both vessels on one side, the arrangement is found to be quite common (4.8 per cent; 17 in 350 thighs).

²The lateral accessory saphenous vein, which occurs commonly in the present authors' series, is not listed in the IMA terminology however as the literature it has been described under a variety of names. Edwards (1930) has pointed out the importance of this lateral vessel from clinical standpoint.

The lateral superficial connections of the dorsal superficial vein of the penis do not alter the present scheme of typing. When such connection exists, it is by way of either a single or double external pudendal vein or by way of a specially duplicated superficial epigastric vein. It has its origin in connection with the left side as was brought out by Ors (quoted by Fowler and Cherry).

³Usually the great saphenous vein divides lower in the leg or receives small branches lower in the leg from the region drained by the medial accessory saphenous vein.

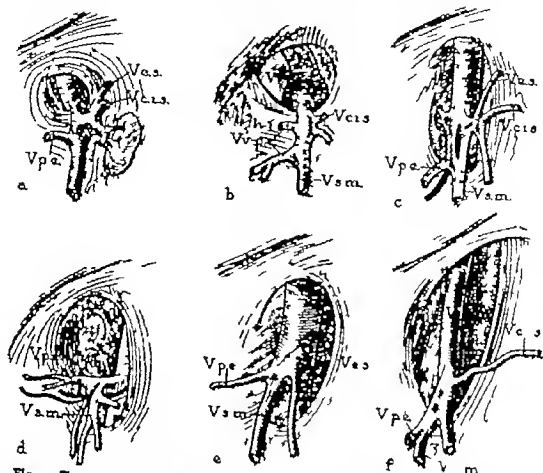


Fig. 4. Types of fossa ovalis, with related vessels. Figure 4a, smallest fossa, Figure 4b, small circular fossa, with femoral artery fully exposed. Figures 4c and 4d, large oval fossa, with femoral artery concealed and femoral vein wholly or partially exposed, saphenous vein receiving deep tributaries within fossa. Figure 4e, large oval fossa, with lateral half of artery concealed by fold-form margin. Figure 4f, largest fossa (in 300) with artery fully exposed. Adapted from Anson and McVay 1938.

cerv (Fig 3d) These may be received proximally rather than distally with the result that several veins from a region converge upon a short trunk (Fig 3d) When a vein drains one area chiefly, but closely skirts another it may receive a tributary from the latter for example an extra epigastric may enter the circumflex iliac (Fig 3c) Almost always the accessory saphenous veins are much smaller than the great saphenous. With similar degree of constancy tributaries empty into the saphenous (separately or by conjoined trunk) on their own side of the chief vessel. Rarely however the superficial epigastric crosses to the lateral side to end on the opposite aspect of the saphenous (Fig 3g) It is important, surgically to know over how great a length of the saphenous vein tributaries of the proximal group will enter the main channel. In a consecutive series the

distance from the termination of the femoral to the most distally placed tributary was 1 centimeter or less in 15 per cent of cases, 1.1 to 1.5 centimeters in 26 per cent, 1.6 to 2 in 24.5 per cent, 2.1 to 2.5 in 16 per cent, 2.6 to 3 centimeters in 9 per cent, 3.1 to 3.5 centimeters in 5.5 per cent, 3.6 to 4 centimeters in 3 per cent and over 4 centimeters in only 1 per cent. This means that in the great majority of cases (96 per cent) the tributaries are received by the saphenous vein in the last 3.5 centimeters of its length, close to or directly over the fossa ovalis.

c. *Fossa ovalis and femoral vessels* The fossa ovalis is regularly pictured as an elongated fault in the fascia lata situated just distal to the inguinal ligament, and as being considerably larger than required for transmission of the saphenous vein. In some illustrations in standard textbooks, the fold

form margin is shown extending lateralward to cover the femoral artery. In others, approximately half the artery's width is exposed beyond the free margin of the fossa. Actually both arrangements are common.

In an earlier study conducted in the authors' laboratory (Anson and McVay 1938) on 200 thighs, the smallest fossa encountered measured 1.6 centimeters in length and was circular in form (Fig. 4a) the largest was 8.5 centimeters long and 3.5 centimeters wide (Fig. 4f). In 90 per cent of the specimens the length was between 3 centimeters (Fig. 4b) and 6.4 centimeters (Fig. 4e) the average length was 4.6 centimeters. In 87 per cent the width was between 3.9 centimeters and 1.5 centimeters the average width was 2.8 centimeters. The femoral vein was found to be exposed through its full width in virtually every specimen. In 83 per cent of 100 consecutive specimens the femoral artery also was wholly or partially exposed. More specifically in 36 per cent three-fourths to all of its width was in view (Fig. 4f) in 30 per cent, one-half to one-fourth (Fig. 4e) not infrequently (17 per cent) the artery was fully exposed with space remaining between the vessel and the margin of the fossa (Fig. 4b). In some cases venous tributaries were found to come forward through the fascial floor of the fossa to empty into one of the lesser tributaries or into the saphenous itself (Figs. 4c and 4d).

2. SURGERY

It is established beyond threat of denial that a surgical technique is best when it pays greatest heed to the normal fabrication of the human body. By the same token it is true that refinement of anatomic concepts of structure makes for less disturbing surgery. When a particular method depends heavily upon anatomical descriptions and figures of stereotyped order—such as are found in standard textbooks—the possibility of technical improvement is decreased, and the surgeon's feeling of security is, as a consequence lowered. But when on the contrary the surgeon is armed with detailed foreknowledge of common variation in structural pattern and has access to actual pictorial records of paramount features in their most

frequent interrelationships, he is equipped to move with ingenuity and surety.

In treatment of varicosities of the saphenous vein and its tributaries, by high ligation, the skin incision begins at the level of the inguinal ligament 2.5 centimeters medial to the femoral artery the pulsations of which are palpable from the surface. An incision 5 centimeters long is found to give satisfactory exposure of the saphenous vein in its proximal portion where tributaries reach the areas of 'torcular' junction of the saphenous and femoral veins.¹ The incision should incline slightly medialward as it descends, to match the long axis of the saphenous vein which departs from the less oblique one of the femoral vein. As mentioned earlier the saphenous vein lies in the deeper layer of the superficial fascia. The chief tributaries are lodged in this layer as are also the lymph glands and their arteries of femoral source and their veins of femoral or saphenous termination. This means that the incision may be carried quite safely through the superficial fatty layer of the superficial fascia.

The saphenous vein is next freed from its fibrous covering of fascia from the point of entrance into femoral downward for a distance of 3 centimeters or more. It is readily distinguished from the femoral vein since the latter lies not only subjacent to the saphenous, but under the superior and inferior margins of the fossa ovalis in which situation it is invested by a fairly heavy prolongation of the femoral sheath. The stripped length of 3 centimeters is almost always sufficient to expose all of the converging tributaries in the present authors' studies it was found that the area of reception of tributary veins rarely exceeded that length.

Since any or all of these tributaries may open into the broadened saphenous at its junction with the femoral the confluence is then to all intents and purpose with the femoral itself. From the surgical standpoint this means that it is unsafe to ligate the saphenous only the tributaries should be

¹In this and in preceding parts of the discussion the account of technique has been adapted from Oschner and Mahomet's excellent monograph; the observations on anatomy are the joint conclusions of the several co-authors of the present article, while the surgical notes are based upon observations made by the senior author, Dr. E. H. Incester.

ligated separately (Fig 5) At first sight it might be considered satisfactory to ligate the confluent channel (cf Fig 2f) Actually how ever such a procedure would be venturesome since the channel being short might not retain a ligature after excision of a segment of the great saphenous vein (see hereinafter) All of the tributaries of the saphenous should be ligated, since unligated veins even when small, are likely to bring on recurrence of the varicosities especially in the case of the lateral accessory branch. It is worth recording that several cases have been observed in which large lateral accessory branches have been mistaken for the great saphenous vein and ligated in its stead and that lateral accessory saphenous branches which are equal to or larger than the great saphenous trunk are not uncommon

In mobilizing the saphenous vein and its satellites it is advisable to free the vessel somewhat from its ensheathing tissue proximalward to its point of junction with the femoral in order to be certain of the position of the latter Failure to make adequate exposure in a case recently observed, led to misidentification of the femoral vein mistaken for the great saphenous the femoral was ligated and severed.

It is important to realize that varicose dilatation of a tributary may simulate hernial enlargement, when the swelling lies over or near the fossa ovalis. One of the authors has seen a case in which enlargement of the superficial circumflex iliac vein was incorrectly diagnosed as a femoral hernia.

Regardless of whether the tributaries be closely grouped in tunicular fashion or segregated, a segment of the saphenous trunk should be removed (between proximal and distal ligatures) to render improbable regeneration and re-establishment of vascular connections (Fig 5) Simple ligation without severance of the saphenous vein or of its tributaries is likely to result in recurrence of varicosities The proximal ligature should be placed as near the point of emptying of saphenous into femoral as is technically possible. When a long proximal stump of the saphenous remains the possibility of thrombosis, with subsequent embolism, is greatly increased

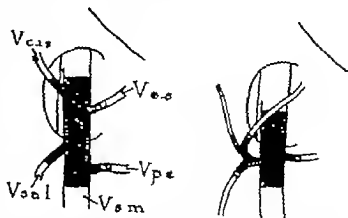


Fig 5. Technique of high ligation of saphenous vein and tributaries: two patterns of venous pattern shown. Stippled area indicated segment to be removed after ligation.

Removal of a segment of the saphenous is the only dependable way of providing a substitution valve in the territory of the saphenofemoral junction. Because varicosities in the saphenous system are the result chiefly of valvular incompetence at the saphenofemoral junction ligation of proximal tributaries only would bring relatively slight hydrostatic relief to the main recipient vein (i.e. saphenous). But when the saphenous (with its weakened valves) is ligated and cut, recurrence is obviated the most troublesome segment has been extirpated and the vascular stream has been strongly diverted through numerous lesser channels whose structure is less impaired.

Several additional anatomical features require practical consideration. These are the regular presence of branches of the femoral artery in and near the fossa ovalis the exposure of the femoral artery itself within widely open fossae the occurrence of communicating veins from deep (muscular) level and of veins received from lymphatic glands.

The arteries referred to are those for which the veins herein considered serve as *venae comites*. Usually they match each other in course. Sometimes, however the arteries pass beneath the saphenous en route to their areas of inguinal, femoral or pudendal supply or emerge through lesser hiatuses in the fascial margin of the fossa ovalis being thus unpredictable in position. This feature coupled with the fact that they are occasionally large makes it advisable to exercise care

in mobilizing the tributary veins where they reach the fossa. Transection of the arteries could cause troublesome bleeding.

While the femoral artery is more likely to be beneath the deep fascia at the falciform margin than to be exposed medial to the latter's free edge, instances are not uncommon in which the latter arrangement obtains (Fig 4). In rare instances the artery is exposed in full width and for a length of 8 centimeters or more. Although fossae tend to be wide when they are long and hence assume an oval outline, exceptional width may be exhibited by fossae of ordinary length—so that the femoral artery lies unguarded in a circular fossa.

It is well known that communications with veins of muscular level occur at variable intervals along the entire course of the greater and lesser saphenous veins; they pass through small hiatuses in the pedal crural and femoral portions of the deep fascial investment of the lower extremity. It is not generally recognized however that vessels of communicating type may occur within the confines of the fossa ovalis. Such vessels emerge through the pectineal fascia on the floor of the fossa, to terminate quickly in the saphenous vein (Fig 4c and 4d) or in the femoral. In "anchoring" the saphenous to subjacent veins they render mobilization of the vessels more difficult.

Veins draining the lymph glands of the inguinal and subinguinal groups are regularly of dissectable size and occasionally as large as the epigastric and circumflex iliac veins (Fig 4a). They could cause troublesome bleeding were they inadvertently cut and left unligated. The same would apply to transection of the companion arterial branches from the femoral.

CONCLUSIONS

In a study of the subcutaneous veins tributary to the great saphenous vein at or near the latter's termination in the fossa ovalis, it was found that vascular patterns (from 350 thighs) could be arranged in eight general types according to the degree of complexity and of tributary fusion. Fusion of two adjacent tributaries entering one side of the saphenous vein occurs very frequently fusion to produce a common trunk on each of the two

sides in the same specimen is uncommon as is also independent termination of all tributaries. However no matter whether conjunction or separateness obtains, the tributaries enter the saphenous vein over the area of or just distal to the lower margin of the fossa ovalis in more than half of the cases they enter the saphenous in its upper 2 centimeters, and rarely over an area greater than 3.5 centimeters in length (measured downward from the femoral termination of the saphenous). These observations mean, surgically that the area of required exposure of the saphenous vein need not be extensive a length of approximately 4 centimeters would be more than adequate in most instances. Width of the area would be governed by the type of tributary pattern revealed in tracing the veins peripheralward from their terminations.

These venous channels from abdomen, perineum and thigh are lodged in heavy fibrous tissue which lies just external to the deep fascial investment (*fascia lata*) of the musculature of the thigh; only their lower tributaries course through the fatty pannicle from subcutaneous level. As the larger veins (epigastric, pudendal, etc.) approach the saphenous, the fibrous tissue forms for them a grossly demonstrable coat, which, traced with them into the fossa ovalis, becomes the strong femoral sheath. This sheath is actually bilaminar its outer lamella being a prolongation under the inguinal ligament, of the transversalis and iliac fasciae, its inner lamella being a similar derivative of the heavy fibrous layer of retroperitoneal tissue. The main venous tributaries of the saphenous thus lie next to the *fascia lata*, their depth below cutaneous level increasing with obesity of the subject. The femoral vein is situated on the floor of the fossa, upon the fascia covering the pectineus muscle. Its free (anterior) surface is flush with the plane of iliac (lateral) portion of the *fascia lata* where the latter forms the falciform margin of the fossa. This is tantamount to saying that, from the surgical standpoint, the veins which come into the field of varicosity ligation are predictably located in relation to fascial planes, and, to some extent, protected from inadvertent transection. The femoral artery in more than

three fourths of cases is exposed within the fossa (i.e. extends medially beyond the falci form margin) for part or all of its width—a circumstance which requires care in dissecting down upon the adjacent femoral vein.

The regular occurrence of iliac epigastric, and pudendal branches of the femoral artery and the occasional presence of intrafossal venous tributaries from muscular sources are additional anatomical features which increase the need for surgical caution.

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THORACOABDOMINAL WOUNDS

A Review of 270 Cases

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THIS report is a review of patients with thoracoabdominal wounds admitted to a General Hospital in Italy between November 16 1943 and February 28 1945. The data were obtained from a survey of the total admissions of American or Allied troops. During this period 270 patients were admitted with the diagnosis of one or more perforations of the diaphragm. This number represents an incidence of 1 per cent of the total of 26,852 patients admitted, and 1.9 per cent of the total of 14,112 patients who were either battle casualties or injuries. The report does not include a rather large number of patients who had separate penetrating wounds of the abdomen or chest. It reviews only those patients who had a perforation of the diaphragm by a metallic foreign body.

Between April 1 1944, and December 30 1944 this hospital functioned as an active chest center. During this period there were exactly 1,000 patients admitted to the chest service. One hundred and eighty-two (18.2 per cent) of these patients so called chest cases, had thoracoabdominal injuries.

All patients in this series were white males except one a negro. Their average age was in the low twenties.

Fifty-two cases (19.3 per cent) were due to machine gun or gunshot wounds, and 218 (80.7 per cent) were due to shell fragments.

The report will be discussed under the following division: (1) type and incidence of traumatic lesions, (2) therapy in forward hospitals, (3) therapy in the general hospital, (4) complications, (5) results and disposition of patients, and (6) summary.

TYPE AND INCIDENCE OF TRAUMATIC LESIONS

Few thoracic and abdominal organs are immune to injury in penetrating or perforating

thoracoabdominal wounds. In this series, the adrenals and bladder are the only organs which were not injured. Table I shows the variety and incidence of the various thoracoabdominal lesions and the more serious of the concomitant lesions sustained by the patients. Only 48.5 per cent of the patients had pneumothorax, hemothorax, or hemopneumothorax. It is believed that the actual incidence was higher but the degree was so mild that the condition was not listed as a diagnosis.

THERAPY IN FORWARD HOSPITALS

The possibility that a bullet or shell fragment may have perforated either the thoracic cavity or abdominal cavity or both is the problem that presents itself with each patient who sustains an injury to the chest or abdomen particularly the lower chest. It requires skillful surgical judgment in the early evaluation of the lesions in these patients and no less skill in the proper operative treatment. In penetrating as well as perforating tangential wounds the surgeon must choose between an exploratory laparotomy, thoracotomy, thoracotomy with transdiaphragmatic abdominal exploration, a separate thoracotomy and laparotomy, or a simple débridement of the wound. That no one approach has found universal favor is shown by reference to Table II. One patient had a left thoracotomy, a laparotomy and a right thoracotomy at his initial operation.

X-ray films in suspected thoracoabdominal injuries may be misleading particularly if the plate is underexposed, if read when wet and by an inadequate light. Under these conditions small intra-abdominal foreign bodies may be overlooked. Early clinical signs may also be mild or be masked by other injuries such as brain or spinal cord lesions, burns, severe fractures and similar injuries. It is to the credit of the surgeons in the forward hospitals, therefore, that only 5 of the 270 pa-

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TABLE I.—TYPE AND INCIDENCE OF TRAUMATIC LESIONS

Type of lesion	Cases	Per cent
Thoracoabdominal Lesions		
Perforation of right diaphragm	159	58.9
Perforation of left diaphragm	107	39.6
Perforation of right and left diaphragm	4	1.5
Perforation or laceration or both of lung	94	34.0
Haemothorax, hemothorax, or hemopneumothorax	131	48.3
Retained foreign body in lung	10	3.7
Perforation or laceration or both of right lobe liver	138	51.1
Perforation or laceration or both of left lobe liver	17	6.3
Total cases of liver injury	155	57.4
Retained foreign body in liver	13	4.8
Perforation or laceration or both of spleen	63	23.0
Perforation or laceration or both of right kidney	19	7.0
Perforation or laceration or both of left kidney	17	6.3
Total cases kidney injury	36	13.3
Laceration renal artery	1	0.4
Perforation or laceration or both of stomach	33	13.0
Laceration of colon	15	5.6
Laceration small bowel	11	4.0
Laceration pancreas	4	1.5
Laceration gall bladder	1	0.4
Laceration pericardium	5	1.9
Laceration heart	3	1.1
Concomitant Lesions		
Compound fractures, other than ribs	44	15.6
Peripheral nerve palsy	15	5.6
Spinal cord injury	4	1.5
Brain injury	3	1.1
Amputations	5	1.9
Burns, second and third degree	1	0.4
Laceration right common iliac vein	1	0.4

tients with thoracoabdominal injuries were evacuated to the base hospital without the presence of thoracoabdominal injury having been recognized and without any operation having been done. These patients were evacuated during periods of extreme activity on the front at which time large numbers of casualties were flooding the field and evacuation hospitals. Two of these patients were received within 24 hours after injury so the time interval was not greatly in excess of that which would have elapsed had the patients had an operation in the forward hospitals. Two were received and operated upon 3 days after injury. Another had no immediate serious consequence of the wound and had no operation.

The variety of primary surgical procedures which were necessary is shown in Table III. The records showed only 60.5 per cent of the cases in which the diaphragm had been su-

TABLE II.—PRIMARY OPERATIONS AT FORWARD HOSPITALS

Operations	Cases	Per cent
Thoracotomy	70	25.3
Laparotomy	62	23.0
Thoracotomy with transdiaphragmatic abdominal exploration	59	23.8
Debridement of wounds, only procedure	29	11.7
Laparotomy and thoracotomy	23	9.3
No surgery	5	2.0
Total	248	100.0
(No record available as to type of operation)	21	
Total	270	

tured. In only 1 case however was mention made that the diaphragm was *not* sutured. Similarly only 9.7 per cent of the cases were reported to have closed intercostal catheter drainage of the pleural cavity following initial operation. Only one half of the total number of patients having a wound of the liver had postoperative subcostal drainage of the liver or the subphrenic space.

Practically all of the patients received transfusions and plasma before and after the initial operation as well as sulfonamide penicillin or both. Records were not available as to the duration of therapy with these drugs. Sulfadiazine was the sulfonamide usually given and was administered in doses of 1 gram every 4 hours. Penicillin was given in the dosage of 25,000 units every 3 hours.

THERAPY IN THE GENERAL HOSPITAL

For the entire group of cases the average time after injury until admission to this hospital was 18.9 days. The longest time interval was 129 days, the shortest 1 day.

It is interesting and very important to note that 43 per cent of the patients required no further operation at the base hospital. This does not mean that the patients did not require further therapy. On the contrary many of the patients required a great deal of attention such as frequent thoracentesis, blood and plasma transfusions, dressing of wounds and colostomies and changing of casts. The most frequent surgical procedure was wound closure. A total of 98 patients, 36.3 per cent, had secondary closure or secondary closures plus skin grafts. Thoracotomy for empyema was performed in 30 cases, 11.1 per cent. This pro-

TABLE III.—PRIMARY SURGICAL PROCEDURES PERFORMED AT FORWARD HOSPITALS

Surgical procedure	Cases	Per cent
Suture of diaphragm	150	60.5
Drainage of liver subcostal.	45	18.1
Packing of liver gauze	24	9.7
Total cases with subphrenic or liver drainage	69	27.8
Suture of liver	7	2.8
Packing of liver with muscle	4	1.6
Splenectomy		
Transdiaphragmatic approach	33	3.3
Abdominal approach	0	4.0
Total splenectomies	43	17.3
Packing spleen with muscle	1	0.4
Suture stomach	28	1.3
Colostomy	14	5.7
Suture small bowel	4	1.6
Resection small bowel, partial	1	0.4
Nephrectomies.		

Right:

1. Abdominal approach 3 1.2
2. Transdiaphragmatic approach 3 0.8
3. Renal approach 0

Left:

1. Abdominal approach 8 0.8
2. Transdiaphragmatic approach 6 2.4
3. Renal approach 0
- Total nephrectomies 3 3.2
- Drainage of kidney 8 0.8
- Suture of kidney 8 0.8
- Suprapubic cystostomy 8 0.8
- Ligation right common iliac vein 1 0.4
- Suture of heart 1 0.4
- Suture of lung 8 8.5
- Intercostal catheter drainage 44 9.7
- Partial lobectomy 8 0.8
- Laminectomy 0.4

cedure usually consisted of a resection of a few inches of rib under local anesthesia and institution of closed drainage. A decortication of the lung was done in 3 cases for chronic empyema and also in 2 cases for organizing clotted hemothorax. An attempt was made to perform decortication of the lung in another case with chronic empyema but without success. There was an exploration of the subphrenic space in 14 patients 5.2 per cent and 11 of these had a subphrenic abscess which was drained. Table V shows the other procedures performed at this hospital.

Of the 5 patients admitted without previous operation 4 had primary débridement and operation as follows (1) thoracoabdominal exploration splenectomy suture of the diaphragm débridement of wounds (2) abdominal exploration, splenectomy suture of diaphragm débridement of wounds (3) abdominal exploration, suture of jejunum su-

TABLE IV.—SECONDARY SURGICAL PROCEDURES AT FORWARD EVACUATION OR GENERAL HOSPITALS

Operations	Cases	Per cent
Secondary closure of wounds	17	6.9
Decortication		
For empyema	5	2.0
Organizing hemothorax	2	1
Total decortications	7	3
Thoracotomy for empyema	7	2.8
Drainage for subphrenic abscess	6	2.4
Secondary closure of disrupted abdominal wound	1	4
Secondary thoracoabdominal exploration	1	4
Closure of colostomy	1	0.4
Phlebectomy ligation of femoral vein	1	4

TABLE V.—SURGICAL PROCEDURES REQUIRED AT THE BASE HOSPITAL

Surgical procedure	Cases	Per cent
Initial, primary operation	4	1.4
No further surgery required.	110	43.0
Secondary closure of wounds	85	31.5
Secondary closure with skin grafting	15	4.8
Thoracotomy for empyema	30	11
Thoracotomy for removal of foreign body		7
Thoracotomy suture diaphragm, packing liver	1	0.4
Repair diaphragmatic hernia	1	0.4
Intercostal thoracotomy for tension pneumothorax	1	4
Decortication		
Empyema	3	1.1
Organized hemothorax	2	7
Attempted decortication	1	4
Bronchoscopy for teleostasis	1	0.4
Exploratory laparotomy	5	1.9
Drainage or exploration or both, of		
Subphrenic space	14	5.2
Drainage of liver abscess	1	4
Drainage of pelvic abscess	3	
Closure of gastric fistula	1	0.4
Closure of colostomy	12	4.4
Nephrectomy	1	0.4
Removal of foreign body from eye	1	0.4
Amputation	1	4
Orthopedic procedures skeletal traction, etc.	5	1.9
Drainage brain abscess		4

ture of diaphragm, colostomy débridement of wounds (4) débridement of wounds only

COMPLICATIONS

Seven patients in this series died which is a mortality rate of 2.6 per cent. A brief summary of these cases follows:

CASE 1: A white male, aged 28 years, was admitted 38 days after injury, in which he sustained a penetrating wound of the left thorax, with laceration of pleura, diaphragm, stomach, and spleen. He developed empyema of the left pleural space and an

embolic hemolytic staphylococcus brain abscess and died 9 days after admission, 47 days after injury.

CASE 2. A colored male, aged 25 years was shot one day before admission to this hospital. He had a sucking wound of the right lower chest which was debrided and closed at a nearby station hospital. He was transferred to this hospital because of evidence of continued intrathoracic hemorrhage. On the day of admission to this hospital a thoracotomy was performed through the right eighth intercostal space, the liver was packed and drained subcostally, the diaphragm was closed, a bleeder in the pericardial fat was ligated, a laceration of the lung was sutured, intercostal underwater catheter drainage of the chest was established and following bronchoscopy, the patient returned to the ward in good condition. He had a sudden cessation of respiration approximately 30 minutes after returning to the ward and expired. No cause was found for his death.

CASE 3. A white male, aged 23 years, was admitted 10 days after his original injuries which consisted of a penetrating wound of the right thorax with a laceration of the lung, diaphragm, and liver. He also had a wound of the right hand with a fracture of the second metacarpal. At a forward hospital the primary treatment consisted of a thoracotomy with removal of the foreign body from the liver. A muscle transplant was placed in the liver laceration and the diaphragm was sutured. The pleural cavity was drained by catheter postoperatively. The patient ran high fever after admission to this hospital and expectorated bile-stained sputum and vomited bile several times. He was thought to have a subhepatic abscess and operation for drainage was to be performed, but he died shortly after the anesthetic was started. Death occurred 19 days after injury. At autopsy he was found to have subphrenic and subhepatic abscesses as well as an abscess of the liver and a peritoneophrenicobronchial fistula. He also had a massive retroperitoneal hematoma, the cause of which was undetermined, a bronchopneumonia of the right lower lobe of the lung and dilatation of the right side of the heart.

CASE 4. A lieutenant, 24 years of age, was admitted 21 days after injury. He sustained multiple penetrating wounds of the right sternal region with penetration of the right lobe of the liver, wounds of the left scalp, left arm, right thigh, and left shoulder. At forward hospitals he had had a debridement of his wounds, an exploratory laparotomy and several days later drainage of a subphrenic abscess. At this hospital he had a secondary closure of his wounds and an exploratory laparotomy 45 days after injury with drainage of the subphrenic space. He developed multiple biliary fistulas of the abdominal wall and after a long, very stormy course finally expired 45 days after admission, 66 days after injury.

The principal autopsy findings were multiple liver abscesses, subphrenic and subhepatic abscesses, bacteremia due to *Aerobacter aerogenes*, peritonitis, acute bile nephrosis, cholangitis, acute empyema, right bronchopneumonia, left dilatation

of the heart, severe atelectasis of the right lower lobe of the lung, hyperplasia of the bone forming elements of the bone marrow.

CASE 5. A white male, aged 27 years, was admitted to this hospital 29 days after injury. He sustained a penetrating wound of the lower right chest with penetration of the right pleural cavity, diaphragm, and a laceration of the right lobe of the liver. The day following injury at a forward field hospital he had an exploratory laparotomy. A large wound of the liver was found and packed for a period of 10 days, after which the packing was removed. Shortly after the operation, the patient developed ascites and pitting edema of the ankles. He complained of an uncomfortable full feeling in his abdomen and anorexia. Examination on admission to this hospital revealed signs of free fluid in the abdomen with edema of the ankles and toes. There was no evidence of collateral circulation. The liver was not palpable. X-ray examination of the chest showed some elevation of the left diaphragm. The patient ran a temperature in the vicinity of 99.4 degrees during his stay in the hospital. Six days after admission he was given a cubic centimeter of salyrgan and had a marked reduction in the size of the abdomen and moderate diminution of the edema of the feet. Seventeen days after admission the patient walked to the latrine, and while having an apparently normal bowel movement, suddenly developed weakness, air hunger and cyanosis, and expired approximately 10 minutes later. Essential autopsy findings were a massive subphrenic abscess, chronic, right, with terminal rupture into the peritoneal cavity, peritonitis, acute, diffuse, severe terminal atelectasis of lung bilateral, due to compression, cardiac dilatation marked, right.

CASE 6. A white male, aged 23 years, was admitted to this hospital 17 days after injury. He had received a penetrating wound of the left thorax just below the nipple. The shell fragment passed through the pleural space, lacerated the apex of the pericardium, perforated the diaphragm and lodged in the right lobe of the liver. Primary operation consisted of a laparotomy with suture of the diaphragm. The liver laceration was noted but there was no active bleeding. The foreign body was not removed. The chest wound was debrided and one suture was taken in the pericardium and the wound was closed. Four days after injury he began having chills and fever and was diagnosed as having malaria, though smears were negative. He was not acutely ill, and his condition was fairly good on admission. Shortly after admission, he began having almost daily chills and fever of 103 to 104.5 degrees F. Repeated malarial smears were negative. The patient became jaundiced and it was felt that he probably had a subphrenic abscess or a liver abscess or both. Two blood cultures were positive for *Escherichia coli* and two were negative. He did not improve with penicillin given in doses of 25,000 units every 3 hours or to heavy doses of sulfadiazine. Forty days after injury a first stage operation for exploration of the

TABLE VI.—COMPLICATIONS

	Cases	Per cent
Died	7	2.6
No thoracoabdominal complications	172	63.7
Chest complications		
Empyema	43	15.9
Bronchopleural fistula	4	1.4
Hemothorax, clotted, organizing	2	0.7
Atelectasis	4	1.4
Persistent large empyema cavity		0.4
Tension pneumothorax		
Unilateral		0.4
Bilateral	1	0.4
Pleural effusion	1	0.4
Atypical & pneumonia		7
Bronchopneumonia		0.4
Pulmonary embolism, fatal		0.4
Pulmonary infarction	2	0.7
Pericarditis, acute fibrinous		0.4
Abscess of thoracotomy wound		0.7
Abdominal complications		
Subphrenic abscess		
Following previous subphrenic drainage	9	3.3
No previous drainage	6	3.0
Total subphrenic abscess	17	6.3
Liver abscess	3	1.1
Subhepatic abscess		0.4
Bile peritonitis		0.7
Pelvic abscess	3	1.1
Intestinal obstruction		
From adhesions		0.4
Ileus	2	0.7
Abdominal biliary fistula	4	1.4
Biliary and urinary fistula		0.4
Gastric fistula		0.4
Hepatitis with jaundice	8	3.0
Spontaneous extrusion of gall bladder		0.4
Hematuria, cause undetermined	1	0.4
Albuminuria, cause undetermined		0.4
Hydronephrosis		0.4
Thoracoabdominal complications		
Phrenicopleurocutaneous fistula	8	3.0
Peritoneophrenicobronchial fistula		0.4
Diaphragmatic hernia		0.4
Miscellaneous complications		
Embolic brain abscess	4	1.4
Air embolism, cerebral, nonfatal		0.4
Septicemia, clostridial		0.4
Malaria, recurrent		0.4
Thrombophlebitis	3	1.1

right subphrenic space was done and the second stage 10 days later but no pus was found in the subphrenic space nor was any pus obtained with aspiration of the right lobe of the liver. In spite of tremendous quantities of blood and plasma, the patient's blood cells, hemoglobin and serum protein remained low and he developed peripheral edema. This improved with the administration of human serum albumin daily in 100 cubic centimeter doses for 5 days, but the constant septicemia gradually debilitated the patient and he finally expired 50 days after admission, 67 days after injury. Autopsy revealed a small metallic foreign body in the right lobe of the liver which was lying partly within the lumen of a fairly large branch of the hepatic v. i. There was a very small abscess cavity about the foreign body

and some abscess formation had occurred along the missile tract and had apparently recently ruptured into the abdominal cavity. Microscopically the liver showed numerous minute abscesses.

CASE 7 A white male, aged 30 years, was admitted 9 days after having sustained a gunshot wound of the right shoulder which passed through the right thoracic cavity lacerating the diaphragm and liver. He also had a wound of the right hip with an incomplete fracture of the greater trochanter of the femur. Original treatment consisted of débridement and suture of the thoracic wound, a laparotomy and suture of the diaphragm with subcostal drainage of the subphrenic space. Four days after admission he developed a tension pneumothorax on the right and the following day on the left and in spite of bilateral intercostal thoracotomies with catheter drainage the patient expired 5 days after admission, 14 days after injury. Autopsy findings were atelectasis, bilateral, marked hydropneumothorax, right, moderate cardiac dilatation, marked abscess, subdiaphragmatic, right congestion of viscera, marked and extremely wounds as described above.

Table VI shows that the most frequent complication was empyema. There were 43 cases of empyema, an incidence of 15.9 per cent of the 270 cases reviewed. There was only 1 case of empyema which did not have a perforation or laceration of some thoracic or abdominal organ. Of the 43 cases of empyema only 2 4.9 per cent were able to return to limited duty. The others were evacuated to the Zone of Interior for further convalescence. In only one case was there a large persistent empyema cavity present when the patient was evacuated. The average number of days after injury until thoracotomy for empyema was done was 26.6. Only 2 cases of clotted, organizing hemothorax resulted from a total of 131 cases in which a diagnosis of hemothorax or hemopneumothorax was made. In the majority of the cases repeated thoracenteses were done and these were sufficient to cure the hemothorax entirely. It is interesting that clinically only 4 cases 1.4 per cent had atelectasis. This low incidence is probably due to the frequency of bronchoscopy following thoracic and thoracoabdominal operations. There were 17 cases, 6.3 per cent who developed a subphrenic abscess, though the incidence in those cases with previous drainage and without previous drainage at the initial operation was practically the same. However, those patients who had subcostal drainage in liver injuries seemed to do better clinically than

TABLE VII—DISPOSITION OF PATIENTS

Disposition	No. cases	Per cent	No. days A.I. until admission (this hospital)			No. days hospitalization at this hospital			No. days A.I. until disposition		
			Longest	Shortest	Average	Longest	Shortest	Average	Longest	Shortest	Average
Zone laterier	30	55.5	159		3.9	18	5	45.5	5	2	77.5
Limited duty	81	30.4	7		16	131	5	58.3	50	37	74.6
Full duty	24	8.9	24	2	1.8	2	20	28.2	8	4	66
Evacuated to North Africa	7	2.6	3		17.0	26			30	7	27
Died	7	2.6	23		7.0	20	2	3.6	75		4.4
Total—100			A.I.—After Injury								

did those who had no drainage. There was a remarkable absence of generalized peritonitis and a low incidence of localized abscess formation in the abdominal cavity. It is believed that early operation and postoperative treatment with penicillin or n sulfonamide or both in these cases are largely responsible for the low incidence of infection and abdominal complications in general. Only 3 cases, 1.1 per cent, had a diagnosis of intestinal obstruction made and 2 of these were from paralytic ileus. Four cases, 1.4 per cent, had abdominal billy fistula and one had a combined billy and urinary fistula of the right flank. The patient with billy fistula and with hepatophrenicopleural fistula were in general the sickest patients and required more and closer attention and care than did any others of the group. Eight patients, 3 per cent, developed hepatitis with jaundice. It was not determined if this were secondary to the liver injury or if the patient developed the infectious hepatitis which was prevalent in the theater at this time. Acute thrombophlebitis developed in 3 patients, 1.1 per cent. One patient had a phlebotomy and ligation of his femoral vein. There was no record of therapy on the other two.

RESULTS AND DISPOSITION OF PATIENTS

Table VII shows that 8.9 per cent of the patients were able to return to full combat duty an average of 60 days after injury.

An example of this class was the case of a 25 year old white male who was admitted to this hospital 8 days after receiving a penetrating wound of the right thorax with laceration of the diaphragm and liver. He had a thoracotomy after partial resection of the

seventh and eighth ribs, and the diaphragm was sutured. He had an exploratory laparotomy but no visceral damage was found except a laceration of the liver, which was packed. The only therapy at this hospital was repeated thoracenteses for the hemothorax on the right. The patient was dismissed to full duty 41 days after admission or 49 days after injury.

There were 82 patients, 30.4 per cent, who were returned to limited duty in this theater.

An example of this class was the 29 year old white male who was admitted to this hospital 11 days after receiving a penetrating shell fragment wound of the left chest. His injury consisted of a sucking chest wound, a compound fracture of the left ninth rib, a laceration of the left diaphragm, left kidney and spleen. Treatment at a forward hospital consisted of a thoracotomy with transdiaphragmatic abdominal exploration, splenectomy, and drainage of the left peritoneal space through a flank wound. The diaphragm was sutured and the thoracotomy wound closed. Postoperatively he had a hemothorax of the left pleural space. The only treatment required at this hospital was thoracenteses to remove the hemothorax. His convalescence was uncomplicated and he was dismissed to limited duty 55 days after admission, 66 days after injury.

Over one half the patients, 55.5 per cent, in this series were evacuated to the Zone of Interior for further convalescence. Many of these patients, however, were evacuated because of concomitant lesions and not directly due to the thoracoabdominal injury or its complication (see Table I).

An example of a patient with a thoracoabdominal complication was the 25 year old white male who sustained a gunshot wound of the right thorax with a laceration of the lung, diaphragm, and liver. Primary treatment consisted in débridement and closure of the sucking chest wound. Thoracenteses were performed postoperatively and 12 days after injury at a forward general hospital he had inter

costal catheter drainage of the right chest because of bile stained pus in the right pleural cavity. Twenty-four days after injury he had a decortication of the right lung and a closure of a bronchial fistula, and the wound in the diaphragm was closed. Thirty-six days after injury he had a thoracotomy for drainage of a recurrent empyema, and this procedure was repeated 44 days after injury. The patient was transferred to this hospital 66 days after injury and several days later incision and drainage of a subphrenic abscess were done. On the 79th day from the onset of his illness, another exploratory thoracotomy was done with the purpose of doing another decortication because of a persistent, large empyema cavity. It was found to be impossible to decorticate the lung, so the patient was evacuated to the Zone of the Interior 125 days after injury with a large residual empyema cavity. This was the only patient in the entire series who will probably have a considerable degree of permanent disability as a result of his thoracoabdominal wound.

Seven patients in this series who died have been discussed above.

Seven of the patients were evacuated to North Africa and their final disposition is not known.

In the majority of the patients evacuated to the Zone of the Interior their wounds and colostomy if present, were closed and healed. It is believed that only an extremely small percentage of these patients would require future surgery as a result of their thoracoabdominal wound and that the permanent disability therefrom should be practically nil.

SUMMARY

The incidence of thoracoabdominal injury was 1 per cent of all admissions to this hospital

and 1.9 per cent of all battle casualties and injuries admitted.

A wide variety of lesions resulted from thoracoabdominal wounds but the principal organs involved were the liver 57.4 per cent the lung 34 per cent the spleen 23 per cent kidneys 13.3 per cent the stomach, 13 per cent.

The patients were operated upon by a number of different surgeons, who used a variety of approaches, and no one operative procedure has found unusual favor over another.

The average time after injury until the patients were received at this hospital was 43 days. After arrival only 43 per cent required further operation which consisted primarily of secondary closure of wounds with or without skin grafting in 36.3 per cent of thoracotomy for empyema in 11.1 per cent exploration of the subphrenic region in 4.4 per cent colostomy closure in 4.4 per cent decortications or 1.8 per cent 3 for em and 2 for organizing hemothorax.

The mortality rate was 2.6 per cent series of cases. Complications were relatively few with empyema occurring in 15.9 per cent of cases and subphrenic abscesses developed in 6.3 per cent. In 9 cases transdiaphragmatic abdominopleurobiliary fistulas developed. There were no thoracoabdominal complications in 63.7 per cent of the cases.

There were 24 patients who were able to return to full duty and 82 who returned to limited duty a total of 39.3 per cent of the patients who were of further service to the 1st Theatre of Operations.

DECORTICATION IN ACUTE EMPYEMA THORACIS

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THE radical management of empyema thoracis in the acute and subacute phases is an attempt to eliminate chronic empyema. That there is a place for pulmonary decortication in certain cases of acute empyema is now well established. It is the purpose of this paper to discuss briefly the problem and then to present case reports which may be of value in establishing the proper indications for radical or conservative therapy.

Decortication was first practiced in this theater in cases of massive clotted hemothorax.¹ Four weeks after wounding now is considered to be the optimum time for its performance in uninfected cases. Later the same operative procedure was adopted in the management of infections in clotted hemothoraces. In these cases the operation is performed as soon as the presence of infection is established. A few have extended the use of this procedure to the management of the more severe infections in both post-traumatic and postpneumonic empyema. Some have attempted to differentiate infected hemothorax and empyema in discussing post-traumatic infections within the pleura. However, the dividing line is not clear. Without proper therapy the infected clotted hemothorax may result in a most disabling chronic empyema. With radical surgical attack the illness in acute severe post-traumatic or post-pneumonic empyema may be shortened to a few weeks. Infected hemothorax properly may be called empyema.

The writer has formed the following opinions: (a) Closed or open drainage (thoracostomy) is the procedure of choice in small and moderate sized, unilocular post-traumatic or postpneumonic empyema. (b) Thoracotomy with evacuation of the pleura and decortication of the lung is the procedure of choice in multilocular empyema and in total empyema with collapse of the upper lobe. In this group

fall both post-traumatic and postpneumonic infections, including those which develop in large clotted hemothoraces.

The technique of pulmonary decortication has been described by Burford and Samson. Essentially the same technique has been used in the cases which form the basis of this report. Certain points should be emphasized: (a) Intratracheal gas-oxygen-ether is the anesthetic of choice. (b) Prior to operation a cannula should be placed in an ankle vein through which blood may be administered as indicated throughout the operation. (c) Posterolateral thoracotomy with or without rib resection is the preferred approach (Fig. 1). (d) All free fluid and clot are removed from the pleural cavity. (e) The fibrinous membrane-like envelop which encases the lung must be completely extirpated. An attempt is made to develop a cleavage plane between the pleura and this organizing exudate (Figs. 2 and 3). In some cases this is easily accomplished; in others it may be most difficult or impossible. In empyema the fibrinous membrane may be much more densely adherent to the pleura than in uncomplicated clotted hemothorax. It is undesirable to traumatize or remove the visceral pleura but occasionally this is inadvertently done. The resulting air leaks may be plugged with fibrin foam but if this is not completely successful, the multiple catheters which are routinely used, maintain expansion of the lung until the small fistulas are occluded. The fibrinous membrane should be removed from all parts of the visceral pleura including that in the fissures so that complete re-expansion is possible (Fig. 4). (f) It is not necessary to remove the exudate which is densely adherent to the parietal or diaphragmatic pleura. (g) It is well to test for air leaks with physiological salt solution after re-expansion of the lung prior to closure. (h) Large mushroom catheters, size 28 to 34, are placed in the 2d interspace midclavicular line, in the 8th interspace at the posterior axillary line, and in the costophrenic sulcus in the anterior axillary line.

¹Gerson, Paul C., Burford, Thomas H., Brewer, Lyman A., III, and Benkert, Benjamin. The management of war wounds of the chest in a basic center. J. Thorac. Surg. (in press).

These are all connected to separate water-sealed bottles which are placed at least 18 inches below the level of the catheter (i) Intercoastal nerve block with 1 per cent novocain is routinely done at the conclusion of the operation (j) Penicillin 100,000 units in 50 cubic centimeters of physiological salt solution is instilled into the pleura just prior to closure. The posterior catheter is left clamped for a period of 4 hours. (k) Penicillin is given intramuscularly 25,000 units every 3 hours for a minimum period of 24 hours prior to operation and is continued postoperatively as long as indicated.

Penicillin has been given credit for the success of this radical surgery in empyema. It has, at least given the surgeon courage to proceed in the presence of severe infection. Its importance however may have been overrated. It is interesting to note that in one case to be described no penicillin therapy was used. In several other cases gram negative bacilli were the offending organisms. The mechanical factors probably are of much more importance than is chemotherapy. Removal of clot fluid, and fibrinous exudate eliminates most of the culture media for the organisms present. Multiple empyema cavities are converted into one. This cavity is largely obliterated immediately by the re-expansion of the incarcerated lung.

In the author's limited experience with decortication in the management of acute empyema, there have been no fatalities. The cases presented below are representative of the more severe types of infection.

CASE 1: An infantryman was admitted to an evacuation hospital 3 hours after sustaining multiple wounds from a rifle bullet with perforating wound of the right chest, bilateral hemopneumothorax, right abdomen, and paralysis of both lower extremities.

The patient was resuscitated and stabilized before a thoracotomy was performed. At thoracotomy there were revealed intercostal bleeding and perforation of the left diaphragm, as well as two holes in the stomach. The openings in the stomach were closed, the diaphragm was approximated with interrupted silk sutures, then the left chest was closed without drainage. The sucking wound of the right chest was simply debrided and closed. A suprapubic cystostomy was done at this time.

He remained in a critical condition for several days. Six days afterward, in a posterior shell with a suprapubic catheter he was evacuated to a general hospital. Admission note recorded. His condition was fair with complete motor loss of both lower extremities,

as well as loss of sense of touch, pain and position." The patient was moderately dyspneic with signs (initial X-ray films are not available) of fluid at his right base, but aspiration withdrew only 150 cubic centimeters of thin, turbid exudate, which by culturing grew gram negative bacilli. X-ray examination disclosed a bullet lying in the spinal canal at the level of the 1st lumbar vertebra. Emergency laminectomy 12 hours after admission, was performed and the cord was found irreparably damaged. The bullet was removed. The admission temperature was 103.8 degrees F. Postlaminectomy temperature for 10 days ranged from 102 to 103 degrees F. Repeated chest taps on the right obtained only small amounts of foul smelling fluid. X-ray pictures then showed fluid and thickness over the pleura virtually obliterating the right lung shadow.

In view of the fact that the urine was negative and the wounds relatively clean, it was obvious that the pyrexia was all due to the empyema. A catheter was placed in the 6th interspace, posteriorly but drained only a small amount of thick, foul pus.

Fifteen days after admission thoracotomy with decortication was done even in the face of a temperature of 104 degrees F. The thoracic cavity was entered through a posterolateral incision in the 5th interspace. Multiloculated pockets of gelatinous, purulent exudate were found. The lung was collapsed and adherent in the posterior gutter area. A thick organized membrane varying from 1 to 4 centimeters in thickness covered the entire visceral and parietal pleura—this served to obliterate the lung in a collapsed position. The adherent capsule-like sheet was extirpated from the visceral pleura with careful blunt and sharp dissection. Bleeding was quite profuse. It was surprising to note that there was a definitely established vascularity between this fibrous layer and the visceral pleura. At several sites the visceral pleura was torn—attempts were made to close the pleural rents but a small amount of air continued to leak after the lung was inflated, for which reason two anterior as well as one posterior catheters were used. At completion of the operation the lung was re-expanded to 90 per cent of its normal extent. The patient was in very poor condition. Blood pressure had fallen perceptibly and only by forcing blood, cambrine, and artificial respiration was he resuscitated.

During the operation this patient received 1500 cubic centimeters of blood, 500 cubic centimeters of plasma, and 500 cubic centimeters of saline. He was in fair condition on return to the ward. Oxygen was continued and the tubes were connected to water seal bottles.

The postoperative course was surprisingly uneventful in view of his critical preoperative condition (complete transection of his spinal cord). The anterior catheters were removed in 7 days as the lung appeared to be sufficiently out and adherent—the posterior catheter was removed 12 days postoperatively. Chest aspiration was necessary on 3 later occasions. Preoperatively and postoperatively this patient was

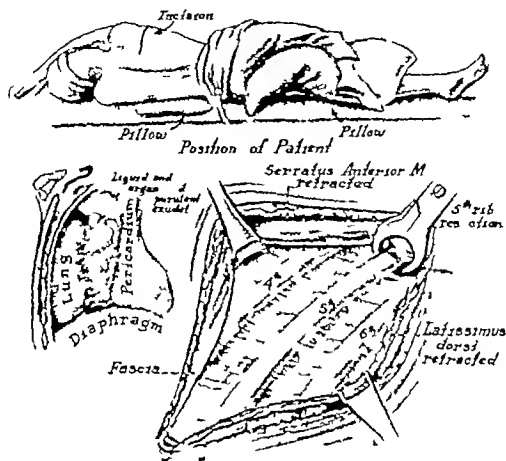


Fig 1. Technique employed in performing thoracotomy with rib resection. An intercostal approach is optional. Cross section is of chest with total multiloculated empyema and collapse of the lung

given large quantities of penicillin as well as sulfathiazole.

Unfortunately, a postoperative x ray film is not obtainable.¹ At the time of his evacuation to the rear 4 weeks after decortication the x ray report reads "Absence of former density and complete expansion of the upper lobe however the diaphragm remains elevated." Nine weeks after decortication the following letter was obtained from the rear hospital to which the patient had been evacuated. At this time his condition relative to pulmonary status is excellent. There is minimal thickening of the chest in the right anterior base. The right lung appears fully expanded. The soldier is afebrile with no complaints of his chest or breathing. As you might judge there has been no change in his paralysis.

Any patient that is so physically handicapped with a complete transection of the cord so extremely toxic with a temperature of 105 degrees F and without the will to live is the worst imaginable operative risk. Ordinarily

one would defer from proceeding with a hazardous operation but in this incident such an undertaking offered his only chance of survival. The results amply justified this risk.

CASE 2 This American soldier was wounded by a shell fragment which produced a perforating wound of the left chest. He lay in an Italian hospital unattended 4 days prior to admission to an evacuation hospital acutely ill with grossly infected superficial wounds and empyema. Treatment was supportive with repeated chest aspirations. Hemolytic streptococci were cultured from the fluid aspirated.

Three days later the patient was transferred to a general hospital. He was in fair condition: dyspneic, temperature 102 degrees F with signs and symptoms (Fig 5a) of pocketed fluid and thickened pleura in the entire left chest area. He coughed continuously producing copious quantities of white frothy sputum without odor. Four hundred cubic centimeters of brownish foul fluid was aspirated from the 7th interspace in the posterior axillary line at which site a No. 24 French catheter was placed through a trocar—specimens taken produced a growth of hemolytic streptococci and gram negative bacilli on culture. The

¹Some of these patients were operated upon 1. base hospital while I was there on temporary duty. Consequently many x-ray pictures are evacuated with the patients prior to the accumulation of the material for this paper.

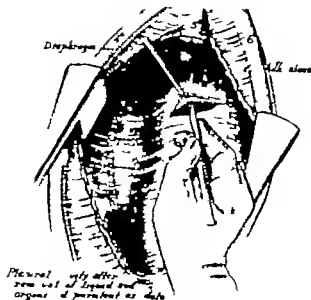


Fig. 2 Technique employed in developing cleavage plane between the organizing exudate and the visceral pleura.

temperature remained elevated to 103 degrees F even though the catheter drained satisfactorily. Further aspiration revealed localized cavities in the anterior and midaxillary areas for which reason (multiloculated empyema) it was deemed wise to proceed with thoracotomy and decortication. In the interim the patient was supported by several transfusions during

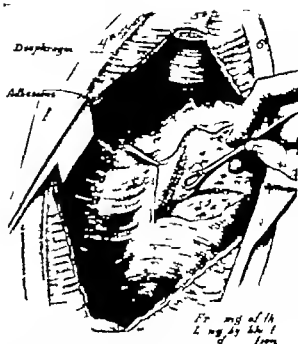


Fig. 3 Method used in removing the densely adherent membrane from the compressed lung.

a period of 7 days. The first 4 days after admission the soldier was given 5,000 units of penicillin every 3 hours then by some misinterpretation of orders, the drug was discontinued and it was never reconstituted.

At operation under intratracheal gas-oxygen-ether anesthesia, through a posterolateral incision with resection of a 3 centimeter section of the 7th rib the pleural cavity was found to be filled with organizing clots of purulent exudate with multiple empyema pockets. The entire lung was collapsed against the mediastinum and enveloped by a thick 4 millimeter tough and very adherent membrane. A clean line of cleavage could not be identified but by slow and tedious sharp and gauze dissection, the greater thickness of this restricting sheet was stripped from the visceral pleura, although a thin membrane was too adherent to be separated except by removing small segments with the visceral pleura. However 90 per cent re-expansion was obtained after inflating the lung with 8 millimeters of positive pressure. A No. 26 catheter was placed in the 2d interspace anteriorly and a No. 32 catheter in the 7th interspace in the posterior axillary line. Before closing in layers with interrupted silk sutures, an intercostal nerve block with novocain was effected of the 3d, 4th, 5th, 6th and 7th nerves.

Prior to the operation blood was started in the right ankle and the left arm 1,000 cubic centimeters, 500 cubic centimeters of plasma and 500 cubic centimeters of 5 per cent glucose were given during the operation. Bronchoscopic aspiration was thought unnecessary postoperatively as the bronchial system was



Fig. 4 Lung completely freed and inflated. Re-expansion of the lung following extirpation of the constricting capsule.



Fig. 5. a, The areas of increased density proved to be multiple pockets of empyema. The entire lung field is further obscured by organizing fibrinous exudate. b, Re-expansion

of lung after decortication. The shadow along periphery, usually termed thickened pleura, actually is an organized membrane over parietal pleura that need not be extirpated.

relatively dry, having been successfully aspirated by a long tracheal catheter.

The postoperative course was without mishap. Both catheters were removed within 16 days without further pocketing or the necessity of aspiration. Twenty-eight days after operation an x-ray film (Fig. 5b) showed satisfactory re-expansion of the lung. Patient was discharged to class B duty¹ 42 days after operation.

We assumed we were protected by penicillin but inadvertently this patient did not receive any penicillin 4 days prior to the operation or any afterward. This case represents supportive evidence that the operation is physiologically sound. Irrespective as to whether penicillin has any specificity against the infecting organism we recommend the continuance of its use.

CASE 3. This infantryman was wounded by small arms fire sustaining a penetrating wound of his right chest. Seven hours after injury a thoracotomy was done in a forward hospital. The right diaphragm was found to have been perforated and the dome of the liver was lacerated. No attempt was made to suture the liver, but subdiaphragmatic drainage was effected through a subcostal flank incision. The diaphragm was closed, then the pleural cavity was closed without drainage.

Class B duty includes any type of duty except combat.

The patient was admitted to a general hospital 8 days afterward, dyspneic, slightly cyanotic, with a temperature of 102.8 degrees F. and signs and symptoms of fluid in the right chest. After aspiration a tube was placed in the 6th interspace in the posterior axillary line; there was obtained foul smelling bile stained exudate from which gram-negative bacilli were cultured. There was also drainage of a similar character from the subdiaphragmatic stab wound. X-ray examination (Fig. 6a) showed the diaphragm to be fixed and elevated. Temperature elevation continued. Penicillin and sulfathiazole were used interchangeably and together for a period of 10 days. The lung was completely collapsed and another fluid level was detected about the drainage tube. For that reason 8 days after admission thoracotomy and decortication were done with resection of the 5th rib in the posterior axillary line. The chest cavity was filled with (Fig. 6b) yellow, bile stained, foul smelling exudate intermixed with flaky, partly organized fibrinous masses of pus. The lung was compressed into a small area in the posterior gutter area. The membrane which was removed from the visceral pleura with difficulty measured 2 to 3 centimeters in thickness. Oozing from the pleural surface was considerable. Transfusions of 1,300 cubic centimeters of blood and 1,000 cubic centimeters of plasma were necessary to sustain the patient. Blood pressure to 90/60 throughout the operation. Numerous leaks in the lung were detected after its reinflation. These were closed with interrupted silk sutures, but to compen-

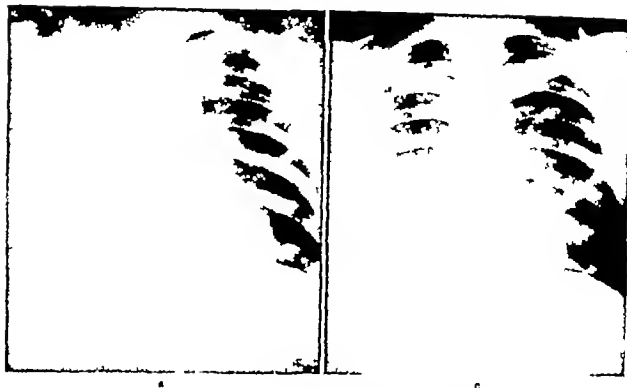


Fig. 6. a, The diaphragm is markedly elevated and the remainder of the right lung field is greatly obscured by pus and organized hemothorax. b, Bile stained, partly organized, purulent exudate overlying the membrane like capsule, which is compressing the lung to the posterior gutter. c, Six weeks after operation, shows satisfactory re-expansion of the lung. The patient was asymptomatic; however the diaphragm remains elevated. This, seemingly has no bearing on the convalescence of this type of case.

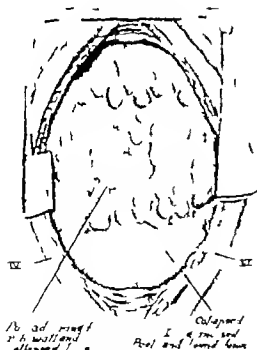


Fig. 6b

safe for any unrecognized leakage, two catheters were placed anteriorly—one in the 2d interspace in the midclavicular line, one in the 4th interspace in the

anterior line, and also one in the 7th interspace in the posterior axillary line. Bronchoscopic aspiration was performed postoperatively for excessive tenacious bronchial secretion. Oxygen was started as he returned to the ward. It should be noted that a communication through the diaphragm 2 centimeters in diameter in the anterior medial area, could be felt, but it was thought the surrounding tissue would not lend itself to plastic repair. A large catheter was placed in the subcostal sinus beneath the diaphragm; this also was connected to a water-seal jug. It was interesting to observe respiratory motion of the water column from this catheter.

Six weeks after operation x ray (Fig. 6c) shows that the diaphragm remains elevated and adherent laterally. Fifty three days after decortication the patient was asymptomatic and was discharged to class B duty.

The infecting organism was a gram negative bacillus. Theoretically penicillin is ineffective against such bacteria. Sulfathiazole was also given though we fully realized drugs of the

sulfa derivation cannot effect bacteria in the presence of pus. More for luck and for lack of courage not to give them both were used. However, we believe they played no rôle in the recovery of this patient. True enough the diaphragm did remain elevated and a lateral shadow was apparent when the patient was discharged. All of which is accountable because of not decorticating the diaphragmatic and parietal pleura. To decorticate the parietal pleura is totally unnecessary. As for decorticating the diaphragm the objections are (a) it prolongs the operation on a seriously ill patient (b) the surface oozed more freely than does the visceral pleura (c) all patients with postoperative high fixed diaphragms seemingly get well satisfactorily soon without this added procedure.

CASE 4. The patient was wounded in action by a shell fragment 7 hours before admission to an evacuation hospital. He had multiple wounds of his arms, right thorax, and abdomen. Resuscitation was adequately carried out prior to debriding the wounds following which an exploratory thoracotomy was performed and then a laparotomy. Through a right thoracotomy approach the diaphragm was repaired. Laparotomy was performed through a separate incision (intra-abdominal viscera were found to be intact). The foreign body was removed from the right retroperitoneal tissue. He was evacuated to a general hospital 2 days later in fair condition. According to the admission note there was considerable subcutaneous emphysema in the right thoracic and upper abdominal regions. Aspiration of the chest revealed 350 cubic centimeters purulent, odorous fluid which was tinged with blood and 200 cubic centimeters of air. X-ray examination (Fig. 7) showed the lung 75 per cent collapsed surrounded by a shadow which was thought to be organizing hemothorax, and also an elevation of the right diaphragm. Repeated aspirations were carried out although only a small amount of thick exudate was obtained. A subdiaphragmatic abscess was found and drained through the bed of the resected 12th rib. However this did not alleviate the temperature elevation and symptoms of toxicity.

Two weeks afterward a decortication was done and 1000 cubic centimeters of thick, odorous exudate was removed. There was found multiloculated empyema rather compartmented in balls of pus. The entire upper lobe was held fast and further compressed by a thick capsule. The fibrous layer on the visceral pleura was stripped away. Bleeding was free. Unfortunately the pleura was torn in the removal of this capsule. Three catheters were used after operation to drain the air and the resultant exudate. Intercostal nerves were blocked inferiorly. The wound was then closed with interrupted sutures of



Fig. 7. Partial collapse of the right lung from what proved to be a multiloculated empyema overlying a thick fibrous membrane. There is elevation of the diaphragm from a fluid and gas containing pocket, which proved to be a subphrenic abscess.

silk. One thousand cubic centimeters of blood and a liter of 5 per cent glucose were necessary to support the patient during the operation. A moderate amount of bloody exudate was aspirated through a bronchoscope at the end of the operation. After he was returned to the ward a Wangenstein suction was applied to the anterior catheter in the 2d interspace—a commercial type of apparatus being used.

The postoperative course was stormy. Suddenly he was found to be unusually dyspneic and it was then discovered that the suction apparatus was improperly connected, thus creating an artificial hydrothorax. The chest was immediately aspirated as oxygen under positive pressure was given but the lung did not re-expand immediately. However it did re-expand gradually and drainage from the posterior catheter continued for a period of 33 days. The temperature ranged from 100 to 104 degrees F. 14 days postoperatively. He was discharged to the Zone of the Interior 37 days postoperatively. There was no evidence of repocketing. His general condition was excellent and the lung had re-expanded to an estimated 85 per cent of normal. (Postoperative x-ray films are not available.)

In patients that have a traumatized compressed lung for a period of 3 weeks or longer it is noted that the lungs are nonresilient to re-expansion and any added difficulty preventing re-expansion serves as a definite hazard.



Fig. 8. a. Almost complete collapse of the right lung from multiloculated empyema and clotted hemothorax. b. Twenty-seven days after operation, the lung is re-expanded.

Although the diaphragm is slightly elevated. The three foreign bodies which are not removed at operation are now visible.

In this case an artificial hydrothorax was produced which added greatly to his period of convalescence. It should be emphasized that only simple home made suction apparatus should be used in these cases. We are opposed to the use of any complicated apparatus as such frequently confuse even the expert attendant.

CASE 5. This patient was injured by a mortar shell which resulted in a sucking right hemothorax, rigid abdomen and a compound comminuted fracture of the right radius and ulna. He was admitted to an evacuation hospital 7 hours after wounding. His condition was fair but he was given 500 cubic centimeters of blood and 500 cubic centimeters of plasma prior to and during débridement of wounds and exploratory laparotomy. The sucking chest wound after débridement was closed without drainage to the pleural cavity; the laparotomy revealed no visceral injury. There was no record of preoperative aspiration. After operation he was aspirated of air anteriorly and posteriorly. Intercostal nerve block, 4th through 11th nerves was effected. The following day 1000 cubic centimeters of air and 400 cubic centimeters of fluid were withdrawn. Two days after operation a temperature of 103 degrees F was recorded. Repeated aspirations yielded a small amount of turbid exudate at three different sites and only 100 cubic centimeters of air. Roentgenogram (Fig. 8a) revealed the lung partially collapsed and obscured by a dense thickness which was thought to be clotted hemothorax. Blood

penicillin and other supportive measures were continued. From the aspirated fluid hemolytic streptococci were cultured. Further aspirations were successful. The patient's general condition was growing worse. In view of the findings it was apparent we were dealing with a multiloculated empyema associated with organizing hemothorax. Any temporizing such as tube drainage would only prolong his hospitalization—first that reason laceration was performed 14 days after wounding.

The 8th rib was resected in the posterior axillary line (the incision was made to usually not avoid the right chest wound). The chest cavity was filled with multiple compartment containing non-odorless, gelatin like fibrin and pus. The lung was 80 per cent collapsed and held down by a well organized sheet of fibrinous exudate. This constricting band was rather easily peeled thus allowing the lung to re-expand completely. Three small foreign bodies were known to be located in the base of the lower lobe, which was the site of a large hematoma. Due to the fact that these foreign bodies could not be palpated, it was felt unwise to attempt their removal. Three catheters were placed: two anteriorly and one in the posterior axillary line. Penicillin (100,000 units) was then introduced into the pleural cavity. Bronchoscopic aspiration at the end of the operation yielded a moderate amount of mucus. One thousand cubic centimeters of blood were given during the operation.

The postoperative course was most satisfactory. A temperature of 99 degrees F was the highest re-



a

b

Fig 9. a. The left chest is obliterated by fluid and a "thickened pleura." At operation it was disclosed to be a sheet, 2 to 6 centimeters in thickness, of organizing exudate. b. Roentgenogram which was taken 4 weeks fol-

lowing operation, shows satisfactory re-expansion of the lung. The shadow which was present at the base was attributed to the remaining fibrinous layer on the diaphragm and parietal pleura.

corded after operation. Catheters were all removed by the 7th postoperative day. Later thoracenteses found no blood fluid or air. At the time of discharge (Fig 8b) the lung had completely re-expanded but the right diaphragm remained elevated and the pleura was thickened at the base. He was discharged 27 days after operation.

This case illustrates early decortication for multilocated empyema and organizing hemothorax with compression of the apex of the lung. The relative ease with which the organized membrane stripped from the visceral pleura is remarkable and may be attributed to early operation without preliminary drainage. It is thought that this method of management should be adopted in those cases of empyema in which decortication is indicated.

CASE 6 This soldier was treated in an evacuation hospital for a period of 10 days following chills, fever and pain in the left chest. Diagnosis there was lobar pneumonia. He did not respond to penicillin therapy. Therefore he was transferred to the medical service of a general hospital. The patient appeared acutely ill with a respiratory rate of 26 and a temperature of 102.4 degrees F. There was dullness over the entire left chest area (Fig 9a) with diminished tactile fremitus. After numerous attempts to aspirate the fluid, 500 cubic centimeters of greenish colored fluid were obtained only from the 5th intercostal space in the midaxillary line. There 50,000 units of penicillin

were injected into the pleural cavity. Cultures showed a few hemolytic streptococci. The patient was transferred to the surgical service 3 days after admission.

Repeated chest taps, local anesthesia being used, located purulent exudate in the 5th intercostal space in the anterior axillary line at which site a catheter was placed through a trocar and connected to a water seal jug. In the 9th interspace in the posterior axillary line fluid of a different character was obtained, a greenish thin transudate. A second catheter was inserted into this pocket. Further taps did not yield additional fluid.

The catheters ceased to drain after 3 days. Knowing that multiple pockets of pus were present, the problem of individually draining them seemed impractical. Therefore we thought the patient was a candidate for decortication.

Five days after institution of catheter drainage thoracotomy with decortication under endotracheal gas-oxygen-ether anesthesia was done. A posterolateral incision with resection of the 7th rib was used. In the posterior gutter the lung was tenaciously adherent and collapsed against the chest wall. Multiple thick walled pockets of cheese like material were ruptured and evacuated. This brought us down on the thick adherent capsule that held the lung compressed. With considerable difficulty the visceral pleura was eventually denuded of this sheath of organizing exudate measuring 2 to 6 centimeters in thickness. Under positive pressure the lung was inflated to normal expansion. Bleeding was very annoying over the entire surface of the visceral pleura.



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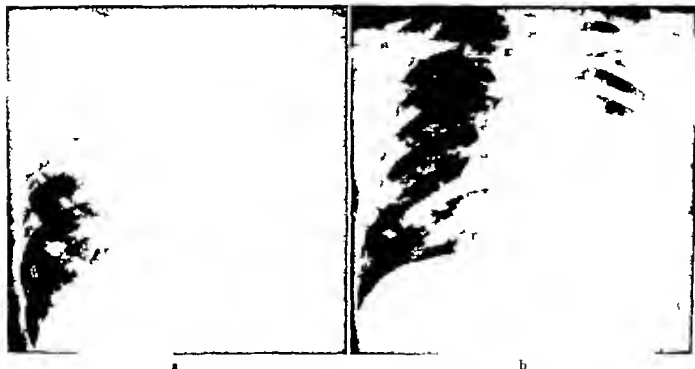


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from which the adherent sheath had been extirpated. Several rents in the visceral pleura were sutured with silk and tested under water for leakage. Closure was made in anatomical layers with silk sutures. Mushroom catheters were placed in the 2d interspace anteriorly and in the 7th interspace in the postero-axillary line. The patient received 1000 cubic centimeters of blood and 1000 cubic centimeters of 5 per cent glucose during and immediately after operation. Following the operation bronchoscopic aspiration was performed for excessive bronchial secretion.

Four days later the anterior catheter was removed. Progress seemed satisfactory. The posterior catheter was removed on the 7th day. No further pocketing developed. X-ray examination (Fig. 9b) showed good expansion of the lung 4 weeks after operation.

Six weeks after operation convalescence was essentially complete with patient ready for discharge to class B duty.

This postpneumonic sequel is uncommon since the advent of chemotherapy. It was interesting to note that the pathology encountered was not grossly different from that in the multiloculated post-traumatic empyema. The capsule however was more tenaciously attached to the visceral pleura and there was a definite increase in the bleeding from the decorticated pleural surface.

SUMMARY

1. The indications for radical and conservative management in acute empyema are briefly discussed.

2. Certain points in the technique of pulmonary decortication for acute empyema are emphasized.

3. Six cases are presented in which thoracotomy with evacuation of the pleura and pulmonary decortication was employed in acute empyema. In one of these cases the empyema was a postpneumonic infection. All others were post-traumatic infections.

4. Early operation without preliminary drainage seems advisable when the indications for the radical management are present.

5. Penicillin was not used in 1 case and was of questionable value in others but its routine use is recommended.

CONCLUSION

Early radical surgical attack in selected cases of acute empyema will greatly reduce the incidence of chronic empyema and "pulmonary cripples."

OSTEOGENIC SARCOMA

II Roentgenographic Interpretation of Growth Patterns in Bone Sarcoma

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THE speech and reports of roentgenologists when concerned with bone tumors are studded with such words as typical 'characteristic' and even diagnostic. Sutherland has stated that given adequate technique the same information that is available in the cut section of tissue prepared for microscopic study can be obtained from the roentgenogram. More recently McNattin relying exclusively on roentgenograms as an accurate method of diagnosis has proposed that the primary treatment of bone sarcoma should be by massive doses of x radiation even to the point of necrosis.

It should be emphasized that the authors of this essay are not diagnostic roentgenologists but we believe that radiographic arbiters such as Sutherland and McNattin ascribe to bone tumors a fixity of roentgenographic pattern that simply does not exist. Our thesis is that the roentgen ray study of bone tumors is an interpretation of the activity of the neoplasm and equally of the character of the stromal response. Thus the appearance of a bone tumor at a given time depends upon the balance between neoplastic activity (osteolysis) and the degree of cortical and medullary reaction (sclerosis) as well as the absence or extent of ossification and calcification. The sunray appearance of many osteosarcomas may be due either to new bone formation or calcification in parallel striae and may be seen in chondrosarcoma and even in neoplastic metastatic lesions of bone. Even Codman's time honored reactive triangle may be seen in chronic periostitis. In short typical roentgenographic features are a reflection of growth characteristics rather than an indication of tumor types *a kinetic rather than a static concept*.

The observations presented here are part of a study of 118 cured cases of bone sarcoma.

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and a smaller number of uncured cases from the Registry of Bone Sarcoma of the American College of Surgeons. The primary objective in the review of these cases was to determine whether there were special features in the natural history and histopathology of the cured cases sufficiently distinctive to account for their curability. Such features have been established and were the subject of another communication but certain general features of histopathology and nomenclature are highly pertinent here.

Of first importance is the definition of terms. The expression osteogenic sarcoma is used widely and interchangeably to signify a malignant tumor originating in or producing bone. We accept the term as indicating an origin in bone but not necessarily producing bone a definition which is also approved by Ewing and other writers. Osteogenic sarcoma then becomes a generic name for those sarcomas arising in the connective tissues of bone distinguishing this numerically large group from those of less frequent incidence arising in hematopoietic endothelial and adipose tissue elements of the medulla.

Two of the connective tissue sarcomas of bone are well known those predominantly producing bone and cartilage osteosarcoma and chondrosarcoma. Our study of the cured cases emphasized the importance of the third member of the group which is fibroblastic in nature. The proposed division of the connective tissue sarcomas is shown in the classification presented here in which bone producing sarcomas are designated as osteosarcoma a proper etymological expression to match the terms chondrosarcoma and fibrosarcoma. The roentgenologist may make a diagnosis of osteogenic sarcoma with reasonable expectation of verification if there is evidence of a cortical malignant tumor. This study has led us to the



Fig. 1. Left: Metastatic adenocarcinoma simulating primary osteogenic sarcoma.
Fig. 2. Chondrosarcoma, early peripheral. () B.S.R. N 5

conclusion that radiographic criteria are highly unreliable in attempting a more accurate differential diagnosis of osteogenic sarcomas.

The prognostic importance of differentiating the three connective tissue sarcomas however is shown in Table I. Osteosarcoma or true bone producing sarcoma is a highly lethal disease represented by less than 12 per cent of the cured while it accounts for 40 per cent of the fatal cases. (Table I). Fibrosarcoma is the

(Numbers in parentheses refer to schematic chart) Fig

least malignant member of the group accounting for 37 per cent of the cured but only 15 per cent of the uncured patients. Chondrosarcoma seems to occupy a median position between these two extremes.

An interpretation of the growth pattern of bone tumors by experienced roentgenologists, according to a kinetic concept should differentiate with almost complete accuracy between benign and malignant tumors. While the differential diagnosis of bone sarcoma into tumor types by radiographic methods seems

MODIFIED CLASSIFICATION OF BONE TUMORS

Type of tumor	Malignant	Benign
Connective	Osteosarcoma Chondrosarcoma Fibrosarcoma	Osteoma Chondroma
Undetermined	Malignant giant cell tumor	Benign giant cell tumor Epiphyseal chondromatous giant cell tumor
3. Endothelial	(a) Angiosarcoma (b) Diffuse endothelioma (Ewing sarcoma)	(a) Pilexiform angioma (b) Cavernous angioma
4. Hematopoietic	() Erythrocytoma (b) Myelocytoma, myeloma () Lymphocytoma (d) Reticulocytoma	
5. Adipose	Liposarcoma	



Fig. 3. left. Chondrosarcoma, peripheral. (2) B.S.R. No. 1256

Fig. 4. Chondrosarcoma, peripheral (3) B.S.R. No. 777

to us more speculative the material reviewed permits the recognition of features commonly seen in the connective tissue sarcomas

Osteosarcoma arises in the metaphysis and may be predominantly sclerosing or osteolytic. The sclerosing form is more common and may be peripheral or central in origin. The peripheral sclerosing is the classical type in which the tumor early elevates the periosteum usually with dense radiating striae and Codman's reactive triangle. With continued growth there is progressive sclerosis of the cortex and medulla and soft tissue extension in advanced cases. The only sign of central sclerosing osteosarcoma may be a dense obliteration of the cortical striae while secondary destruction in the medulla produces a mottled appearance.

The pure osteolytic form of osteosarcoma is the old telangiectatic bone aneurysm and represents a rare and extremely anaplastic form. There is irregular expansile destruction of the cortex little or no periosteal reaction. There may be early perforation and bulky soft tissue masses invasion of the epiphysis and adjacent joint.

Chondrosarcoma arises in the ends of the diaphyses of long bones and vertebrae. There are two well defined forms peripheral and central. In the peripheral an irregular productive periosteal growth is the earliest stage. Calcification is extremely common in chondrosarcoma and is responsible for its radiopacity. It may early perforate the periosteum and produce bulky lobulated soft tissue tumors or blotchy irregular masses.

TABLE I — PERCENTAGE INCIDENCE OF FORMS OF OSTEOGENIC SARCOMA IN 5 YEAR SURVIVALS AND IN NONSURVIVALS

	5 year cures		Uncured	
	No.	Per cent	No.	Per cent
Osteosarcoma	1	8		40
Chondrosarcoma	26	47.5	0	40
Fibrosarcoma	27	3.4	7	5
Complex sarcomas				
Not diagnosed				
Nonosteogenic	6			
Total	8		7	



Fig. 5.



Fig. 6.

Fig. 5 Chondrosarcoma, calcifying, peripheral. (4) B.S.R. No. 30.

Fig. 6 Chondrosarcoma, central sclerosing type. (7) B.S.R. No. 3.



Fig. 7.



Fig. 8.



Fig. 9.



Fig. 10.

Fig. 7 Fibrosarcoma, early osteolytic. (1) B.S.R.

N 60.

Fig. 8 Fibrosarcoma, osteolytic. (3) B.S.R. No. 941

Fig. 9 Fibrosarcoma, advanced diffuse osteolytic. (4) B.S.R. No. 1764.

Fig. 10 Fibrosarcoma, ossification. (5) B.S.R. No. 407

OSTEOSARCOMA	CHONDROSARCOMA	FIBROSARCOMA
<p>SCLEROSING FORM PERIPHERAL Tumor early involves the periphery, usually with dense sclerosing areas and Codman's reactive triangles. CENTRAL Dense sclerosing shell forming around areas may be only finding of secondary destructions. Lesions has produced multiple appearances.</p> <p>OSTEOLYTIC FORM Irregular complete destruction of cortex. Little or no peripheral reaction. (2) May early perforate and form bulky soft tissue mass, some of pathological fracture.</p>	<p>PERIPHERAL Irregular peripheral periosteal growth may be earliest sign. (2) May early perforate periosteum, form bulky mass with simple history of lesser areas of osteolysis. (3,4) Calcification may occur on occasion in ray areas. (5)</p> <p>CENTRAL Irregular areas of softness (2) usually with adjacent reactive sclerosis forming shell around tumor. Endosteal areas may remain intact. (6) Lesions may predominate with dense ivory-like obscuration of architecture. (3)</p>	<p>EARLY OSTEOLYTIC FORM Medullary to peripheral periosteal and syndesmosal. May undergo to form simple destructions lesions (2,3), or multiple. (7) Life course (2)</p> <p>ADVANCED DIFFUSE OSTEOLYTIC Less common effects in most of long bones. (8) Linear and circumscribed destructions obscuring elements of sclerosing bone, ragged moth-eaten appearance, simulating through tumor.</p> <p>FIBROSARCOMA WITH OSSIFICATION Fibrosarcoma may have any sort of less sclerosing bone areas (2), linear sclerosing areas simulating or central chondrosarcoma.</p>
<p>LOCATION Most cases in metaphysis. Most common lower limb, upper limb. Usually in bone may involve epiphysis and adjacent joint.</p>	<p>LOCATION Is made of shafts of long bones. Part bone and periosteum.</p>	<p>LOCATION Any part of long bones epiphysis included. Fragments form of nature of flat bones.</p>

Fig. 11 Roentgenographic interpretation of evolution of osteogenic sarcoma.

of calcifying neoplasm. Calcification may also occur in linear striated style simulating peripheral sclerosing osteosarcoma. The central type of chondrosarcoma often produces irregular areas of rarefaction usually with adjacent reactive sclerosis forming a shell around the tumor. Eroded areas may appear cystic and resemble fibrosarcoma. Sclerosis and calcification may predominate in the central type with dense ivory like obscuration of architecture.

Fibrosarcoma may arise in any part of a long bone epiphyses included. It is a frequent form of sarcoma of flat bones. The most common form is the osteolytic. In its early stage its origin may be evident as medullary cortical or periosteal. It may enlarge to form a single predominantly destructive lesion with little or no reactive sclerosis or periosteal thickening. They are most commonly non expansile tumors. Radiographic evidence of extension is frequently that of an irregular spotty osteolytic process with or without sclerosis of adjacent bone. Multiple cyst like areas are not uncommon and should not be confused with giant cell tumors for the outline of the pseudocystic areas is irregular and there is usually adjacent progressive osteolysis. The microscopic picture is usually entirely comparable to that seen in soft tissue sarcomas. These forms are frequently slow or even indolent in their growth and 5 year cures have been obtained by amputation after repeated local operations.

There is an advanced diffuse osteolytic form of fibrosarcoma less common which affects one third or more of a large bone in which there are linear and circumscribed areas of rarefaction with intervening strands of sclerosing bone. The result is a ragged moth eaten appearance which may simulate Ewing's sarcoma.

In any soft tissue fibrosarcoma ossification may occur. Most ossifying fibrosarcomas in bone in the past have been diagnosed as osteosarcoma. Ossification in fibrosarcoma of bone results in a sclerosing lesion which may be difficult to differentiate from osteosarcoma or sclerosing chondrosarcoma. Ossification may occur only in parts of a fibrosarcoma with other areas of osteolytic character making the diagnosis more plausible.

The simulation of primary bone tumors by metastatic lesions has been repeatedly observed by us in the past 4 years. One of the most striking of these is that shown in Figure 1. This patient's past symptom was that of pain in the thigh just above the knee. The x ray films were diagnosed without equivocation by three roentgenologists as typical osteosarcoma.

When a biopsy was obtained the microscopic features were those of an adenocarcinoma metastatic from the prostate gland. Since this rather astonishing discovery metastatic lesions from the stomach ovary lung and breast have been observed as producing essentially the same picture.

SUMMARY

The roentgenographic interpretation of bone tumors is properly a study of patterns of neoplastic activity and the character of the stromal response—a kinetic rather than a static concept. The roentgenologist can determine with a high degree of accuracy the benignancy or malignancy of a given lesion. Further differential diagnosis of tumor types by radiographic methods must be regarded as speculative. Metastatic lesions may simulate perfectly the appearance of primary sarcoma of bone. Microscopic study of tissue obtained by open biopsy remains as the most essential single diagnostic method in tumors of bone. Ewing's sarcoma (endothelial myeloma) is a notable exception for in tumors presenting

suggestive evidence of this lesion a therapeutic test with small doses of x radiation is a valuable diagnostic aid. In general formal biopsy of bone tumors should precede the institution of any therapeutic program either surgical or radiological. All reliable evidence fails to establish any hazard in open or needle biopsy of bone sarcomas. To employ intensive irradiation of bone lesions on roentgenographic evidence alone is an unwarranted intellectual obeisance to a fallible diagnostic measure.

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ACQUIRED ESOPHAGOTRACHEOBRONCHIAL FISTULA

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ACQUIRED esophagotracheobronchial fistulas are of infrequent occurrence and have a poor prognosis and a high mortality rate. These fistulas are most often associated with malignant disease of the esophagus or trachea and occur as a late or terminal complication of the underlying pathologic process.

One must have a clear concept of the anatomic relation of the esophagus to the trachea in order to appreciate the ease with which these fistulas may occur. The esophagus begins at the level of the cricoid cartilage and descends in front of the vertebral column through the superior and posterior mediastinum. It passes through the diaphragm and ends at the cardia of the stomach. The trachea lies just anterior to the upper portion of the esophagus, being separated from it by a few lymph nodes which are most numerous in the region of the bifurcation. As the esophagus descends in the thorax it curves to the left and is crossed by the left main bronchus. It then passes to the right and behind the arch of the aorta and descending in the posterior mediastinum lies to the right of the thoracic aorta. Lower in the thorax it passes to the left and anterior to the aorta. Since the trachea and the upper part of the esophagus lie in such close apposition it is easy to understand how a pathologic process of one organ may spread and involve the other organ secondarily.

CAUSES

There are five main causes of esophagotracheobronchial fistulas. In order of their frequency they are as follows:

1. Malignant disease of the esophagus
2. Infectious disease of the esophagus, trachea or pleura
 - A. Tuberculosis
 - B. Syphilis
 - C. Fungus infections
 - D. Suppurative esophagitis
 - E. Nontuberculous empyema
3. Traumatic injuries of the esophagus
4. Esophageal diverticula
5. Esophagomalacia

Carcinoma of the esophagus is the most frequent cause of fistula formation. Ewald stated

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that 50 per cent of carcinomas of the middle third of the esophagus are associated with fistula. Tinney and one of us (H J M 15) reported a series of 39 cases of fistula in 14 cases (36 per cent) the fistula was associated with carcinoma of the esophagus. In 4 cases (10 per cent) the fistula was the result of a malignant lesion which arose in the thyroid in the trachea or in the bronchus.

Lymphoepithelioma of the lower part of the pharynx may also cause fistula formation. Boyd and Goldbloom have reported a case of this nature.

Infectious diseases of the esophagus, trachea, pleura or adjacent lymph nodes are the second most common cause of fistula. Tuberculosis is a frequent etiologic factor. It may cause fistula formation in several different ways. Heddaeus and Riviere expressed the belief that fistulas may arise from a breaking down of caseous lymph nodes which ulcerate into the trachea and esophagus. In Pachnos' opinion tuberculosis causes an esophageal ulceration with subsequent perforation. Kelly and Henderson expressed the belief that tuberculous lymph nodes may perforate into the trachea and esophagus as the result of a slow process of ulceration on the outer walls of these structures. In their opinion also tuberculous lymph nodes in healing may cause the formation of traction diverticula which enlarge, ulcerate, and finally rupture to form a fistula. Tuberculous ulcers of the trachea or bronchi may perforate into the esophagus and form a fistula. Tuberculous empyema of long standing occasionally will cause an esophagobronchial fistula to form.

Syphilis may cause the formation of esophagobronchial fistula in two ways. It may give rise to gummas in the esophagus or air passages, which eventually ulcerate, perforate, and form fistulas. Bucher and Ono reported 13 cases of this sort. Syphilis also may cause fistula formation through the development of an aneurysm which from prolonged pressure, may produce an esophagotracheal fistula. Dörner has reported a case of this nature.

Actinomycosis is a rare cause of fistula formation but Vinson and Sutherland reported such a case. The patient lived for 20 years after the development of the fistula.

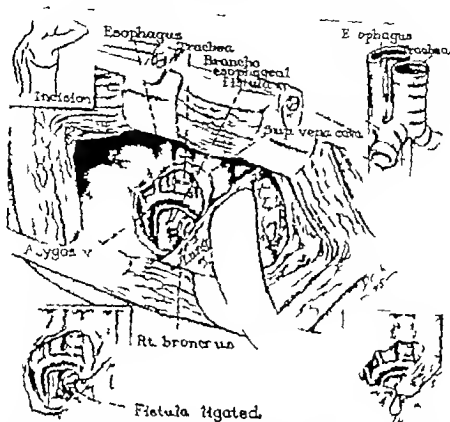


Fig. Fistulous tract between the right main bronchus and the esophagus. Its relation to the azygos vein and to the superior vena cava and the trachea is all seen. Insets show the incision, a larger view of the fistula, the fistulous tract ligated and the reinforcement of the ligated ends of the fistulous tract with pleura.

Phlegmonous or suppurative esophagitis may give rise to a fistula. Such an inflammatory process may result from the action of some corrosive chemical that has been swallowed or it may be secondary to a pulmonary or pleural infection of long standing. Berman and Walters reported a case in which a fistula was due to nontuberculous empyema. In cases of nontuberculous empyema, fistulas are more likely to occur when a hard rubber tube has been used to drain the pleural space for a prolonged period than under other conditions.

Traumatic perforation of the esophagus, either by some foreign body or by instrumentation may give rise to a fistula. Rarely diseased bone in an adjacent vertebra may cause fistula formation. Judd, Havens, and two of us (O.T.C. and H.J.M.) reported a case in which fistula was due to a bullet wound. Surgical treatment of the fistula was successful. Murtagh and Tyson have reported a fistula due to a piece of bone lodging in the anterior esophageal wall. The fistula healed promptly and completely on removal of the bone.

Esophageal diverticula. whether they are of the congenital or of the acquired traction type, occasionally cause the formation of fistulas. These arise because of inflammation and ulceration of the diverticulum with secondary perforation into the trachea or bronchi. Occasionally the diverticula may cause a mediastinal abscess which can rupture into a bronchus, thereby forming a fistula.

Davidson and Mills stated that esophagomallacia is a rare cause of esophagobronchial fistula. This occurs as an agonal manifestation in cases of cerebral disease, as a result of digestion of the esophageal walls by gastric contents.

SYMPTOMS

Although as a rule congenital tracheo-esophageal fistulas manifest their presence at once by a definite group of symptoms, acquired fistulas may be present for varying periods before they produce symptoms. There is generally a history of varying degrees of dysphagia gradually increasing in severity. Then suddenly cough develops as well as dyspnea when the patient eats

and he raises purulent sputum and occasionally blood. At first these symptoms follow the ingestion of liquid foods but later on they may follow the ingestion of either solid or liquid food. Lukens and Ono stated that coughing and dyspnea are most likely to occur when the patient is on his left side in an upright position or leaning forward when he swallows. Allen has reported 2 cases (proved roentgenologically) in which a fistula was present but the patient had not had any symptoms. If one suspects the presence of an esophagotracheobronchial fistula, a bronchoscopic and an esophagoscopic examination should be performed in an endeavor to visualize the fistulous opening. A roentgenoscopic examination of the esophagus should also be performed after the patient has swallowed a small quantity of radiopaque oil. These patients should not be given barium to swallow as it is very irritating to the parenchyma of the lung whereas radiopaque oil is not.

TREATMENT

The treatment of esophagotracheobronchial fistula varies with the cause of the condition. When fistula arises from malignant disease there is really no treatment available, as the fistulas are terminal complications and the patients will die of the malignant lesion regardless of their treatment. Some of the other types of fistula though, are amenable to various forms of therapy. Clerf, Cooley and O Keefe have reported 2 cases in which esophagotracheal fistula was successfully treated by the application of crystals of sodium hydroxide. These crystals were fused on an applicator and pressed against the fistula for 3 minutes. This procedure was repeated 3 weeks later. Imbertoni has reported a case in which a high fistula was treated by excising the fistulous tract and closing the esophagus and trachea separately with interrupted sutures. This procedure was done by opening the anterior wall of the trachea and working on the fistulous opening in the posterior portion of the trachea. When these fistulas arise from empyemas, Cohen and Sindell advocated adequate drainage of the pleura and prolonged esophageal rest by the use of nasal tube feedings or gastrostomy feedings. This regimen is followed until the esophageal fistula has had adequate time to heal. Judd, Havens, and two of us (O.T.C. and H.J.M.) have reported a case in which a traumatic fistula was closed by excision of the fistula and individual closure of the esophagus and trachea with reinforcement of the suture lines by transplantation of the omohyoid muscle into the area.

REPORT OF CASE

We wish to report an additional case at this time in which the fistula was cured by operative intervention. The patient was a 59 year old white woman whose past history was negative except for a previous ectopic pregnancy that had been handled surgically. She had been in good health until 3 years before her admission to the Mayo Clinic. At this time a piece of meat had entered her trachea while she was eating, and, after this, a cough and an aching in her thorax developed. Six weeks later the meat was removed with a bronchoscope. She continued to cough, however, and on one occasion coughed up some pieces of calcified material. Her general health was good until one year prior to admission when progressive dysphagia developed. She soon noted severe paroxysms of coughing on taking liquids and regurgitated the liquids. She gradually lost 40 pounds (18.1 kgm.) At the time of our esophagoscopic examination she was found to have a sinus opening on the right lateral wall in the middle third of the esophagus. On bronchoscopy she was found to have a fistulous opening in the posterior wall of the right main bronchus through which esophageal secretion was coming.

Surgical exploration and closure of the fistula were advised. Preoperatively the patient was given 4 grams of sulfadiazine for 3 days. Transthoracic exploration was performed through a right posterior lateral incision, with removal of part of the sixth rib. Exploration of the esophagus and the lower part of the trachea disclosed a fistulous tract between the esophagus and the right main bronchus with many calcified lymph nodes in the region (Fig. 1). After the fistula had been dissected free, its esophageal end was ligated and turned in with interrupted catgut sutures. The bronchial end of the fistula was ligated separately and covered with pleura. The operative site was washed with saline solution and cephrin chloride (1:10,000) and 5 grams of sulfanilamide were dusted into the pleura. An intercostal catheter was inserted and the thorax was closed in layers. A Levine tube was passed into the stomach. The patient was given 80,000 units of penicillin intramuscularly each day for the first 11 postoperative days.

Jefunostomy feedings were begun through the Levine tube on the second postoperative day. The patient was allowed to drink clear liquids on the seventh day and the nasal tube was removed on the tenth postoperative day. A liquid diet then was begun and was gradually shifted over to a soft diet.

When the intercostal catheter was removed on the fourth postoperative day the lung remained well expanded. Thoracentesis was performed on the eighth and twelfth days and the patient was dismissed on the twenty first day in good condition. She was eating a soft diet and had not experienced any dysphagia, dyspnea, or coughing since the operation. The report of the pathologist on the specimen of tissue that was removed at operation was chronic inflammation and tuberculosis.

CONCLUSIONS

In conclusion one may see that these esophagotracheobronchial fistulas are a serious problem. In cases of fistula caused by some malignant condition the malignant disease itself is fatal. Those fistulas not associated with malignant conditions have a more hopeful outlook, although many of these patients, regardless of the cause of the fistula die of aspiration pneumonia, pulmonary abscess, or gangrene. This is especially true when

the fistulas are of considerable size. Direct surgical attack with closure of the fistula is feasible in some instances and some of the smaller fistulas may be treated adequately by the local application of crystals of sodium hydroxide.

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GUNSHOT FRACTURES OF THE FEMORAL SHAFT

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A ZONE of Operations often affords an unusual opportunity of observing large numbers of compound fractures of the femoral shaft an injury not often encountered in civilian practice. This study is based upon a series of 82 cases received at a General Hospital during the campaign in North Burma from October 1943 to August 1944. It includes all complete compound fractures of the shaft, some of which were comminuted into the knee joint. Purely condylar fractures and those involving the head and neck are not included because they bring up different problems in management. This study has it is believed, enhanced value because the majority (85%) of the cases were Chinese soldiers, and it was possible for us to observe the patients from very shortly after their injury until the time when the end results could be ascertained with a reasonable degree of certainty. American soldiers, comprising 15 per cent of the series, were evacuated to the Zone of the Interior as soon as this could be done with safety. The mortality of the entire group was 4.9 per cent.

There was no significant variation in the side of the body concerned but the lower third of the shaft was most commonly involved. Approximately half of the cases were at this level and 8 of these, 10 per cent of the total, involved the knee joint. Middle third fractures are common in civilian practice, but accounted for only one sixth of this series. The remaining third were in the proximal portion of the shaft. A rifle bullet was said to be responsible for the wound in 51.62 per cent, of the cases, and shell fragments, most frequently from a mortar accounted for the others.

TIME OF ADMISSION

Sixty per cent of the patients were admitted within 48 hours of injury and of these two thirds were admitted within the first 36 hours. Early in the campaign there were delays in evacuation in a number of instances so that the average time interval was 5.9 days from injury to admission. Once the air evacuation system had been perfected, patients were received within an astonishingly brief time, especially when it is realized that a bitter haul for varying distances was required before a plane trip of 100 miles or more.

MANAGEMENT BEFORE ADMISSION

Debridement. It is our opinion that in a great majority of patients the treatment received in the forward areas was of the highest quality. Of the 82 cases, 70 or 85 per cent, had received wound débridement prior to admission. There were 10 patients, 12 per cent, who had not been débrided prior to admission. One of these had a primary type of wound excision performed after admission, but the others presented wounds which were not considered suitable for any procedure other than the providing of adequate drainage. In 2 cases it was uncertain from the data accompanying the patient and from the appearance of the wound whether débridement had been performed. Of the 70 cases in which débridement had been done, the time interval between injury and operation was accurately determined in 66. It is a tribute to the medical personnel in the forward areas that 51.77 per cent, of these were débrided within 12 hours and that only 15.23 per cent, had operations after that period. Of the entire group of 82 patients, it is known that 62 per cent were débrided within 12 hours of their injury.

The débridement, it is felt, was adequate in most cases. Improvement in the condition of the wounds was readily noted as the experience of the forward surgeons increased. In a few cases it was apparent that there had not been sufficient incision of the deep fascia and in some, injured muscle and foreign bodies were not removed, thus causing subsequent difficulties. Occasionally vaseline gauze had been inserted tightly in the wounds and acted as a cork instead of a drain. In such instances removal of the gauze was followed frequently by a gush of purulent material. Wide incision of skin to explore the depths of the wound, and counter incisions posteriorly on the medial or lateral side, were recognized as helpful measures in avoiding wound complications.

It is not known how many patients with this type of injury succumbed to shock or hemorrhage in the forward areas. However it soon became apparent that next to the treatment of shock and hemorrhage, the adequacy of the débridement was the most important part of the primary treatment both as to the saving of lives, the avoidance of soft tissue and bone infection, and the rapidity of convalescence.

Suture In only one instance had the wound been sutured before admission. The sutures were removed upon arrival at the hospital. Our experience with other cases in which battle wounds were sutured primarily has convinced us of the wisdom of the Surgeon General's Circular letter No. 189, dated November 17 1943 which forbids primary suture of such wounds. The gravest complications may ensue if immediate closure is performed. In none of our cases had any form of internal fixation of the fracture been attempted.

Immobilization The commonest type of immobilization used in the forward areas was the plaster spica. Most of these were double spicas, with plaster down to the toes on the affected side and to the knee on the opposite side. Of the entire series, 68 patients, 83 per cent, were so immobilized. Although many of the spica plasters were broken at the groin, the patients were for the most part comfortable, and this method of temporary fixation seemed entirely satisfactory. In 3 cases a Kirschner wire had been inserted through the femur and incorporated in the plaster but this seemed unnecessary. In our opinion the function of the forward stations, once excision and immobilization has been accomplished, is to evacuate the patient to a fixed installation for definitive treatment as soon as possible. If this can be done within a week, only ordinary precautions need be taken for the maintenance of length and for the proper alignment of fragments. The only thing that is required, after the care of the wound and the treatment of shock and hemorrhage, is comfortable transportation by a method which will prevent motion of the fragments. Adequate reduction can be obtained when the fixed installation has been reached.

It is inadvisable to cover with plaster any wound that has not been debrided, unless specific notation of this omission has been written plainly upon the plaster. It is also inadvisable to apply a nonpadded plaster when a patient's circulation cannot be continually and carefully watched. Padded plasters should always be used for transportation. If unpadded plasters have to be used because of lack of suitable material for padding the plaster must be split longitudinally through its entire length. The application of a nonpadded plaster especially in the region of the calf, proved to be an important factor in producing circulatory disturbances in several of our cases. Plaster fixation is a definite disadvantage in those instances in which wound infection is suspected. If infection is likely a window should immediately be made over the wound for early inspection

or the plaster should be removed entirely. It is probable, if earlier wound inspection had been made, that one of the deaths in this series could have been prevented.

In 12 cases, 15 per cent, immobilization was obtained by means of the Army half ring leg splint. This splint gave satisfactory temporary immobilization of the fragments but several points are worthy of mention. Any form of hitch used around the foot and ankle is dangerous because it may produce circulatory obstruction or pressure necrosis. Skin traction by means of broad adhesive strips or stockinette is the method of choice. Circular adhesive strips should not be used. Smoothly applied gauze bandage should be used to anchor the adhesive. Pressure from adhesive over the malleoli and over the head of the fibula should be avoided. The adhesive or stockinette should extend to a point just below the wound. When possible, a wooden spreader should be employed. If the lateral adhesive strip is applied somewhat more posteriorly than the medial one, there will be a tendency to correct the external rotation deformity.

The "Tobruk splint" was not used in any of our cases. In 3 of them, however, the wound and the adjacent arm of the Army leg splint were incorporated in a plaster cuff. It is felt that when there is a shortage of plaster in the forward areas, immobilization can be satisfactorily obtained by means of the Army leg splint, provided that such fixation is not maintained for more than a few days and that no ankle or instep hitches are used. The plaster spica, however, is preferable.

Two patients arrived without any form of immobilization. Both were in poor general condition and had severely infected wounds.

Sulfonamides and antisepsis. In 94 per cent of the patients there was either a written record of sulfanilamide having been used in the wounds or evidence of it on inspection. It is entirely possible that sulfonamides were applied locally to all wounds. In 40 per cent of the cases a history or written record of the oral use of sulfonamides was obtained. It is probable that a large number had taken the drug. Two sulfonamides, sulfadiazine and sulfathiazole were used and these in about an equal number of cases.

A stimulating dose of tetanus toxoid had been administered to all American soldiers prior to admission. Most of the Chinese had received 1500 units of tetanus antitoxin. Those who had not previously received it were given antitoxin at the hospital. No case of tetanus developed. Gas bacillus antitoxin was administered prophylactically in a few selected cases.

In summary, it is our opinion that the following factors are of greatest importance in the early management of these cases (a) treatment of shock and hemorrhage (b) thorough wound débridement (c) local and oral sulfonamide therapy (d) adequate immobilization and (e) rapid evacuation to a fixed installation. Fracture reduction and maintenance are of secondary importance. These are functions of the fixed medical installations.

CONDITION ON ADMISSION

General Although all the patients presented some degree of anemia and malnutrition and showed the effects of exposure only 18, or 22 per cent, were thought to be in poor general condition. This latter group consisted chiefly of patients with wound infection especially by gas-forming organisms, and patients with septic arthritis of the knee joint. The average hemoglobin determination in the entire group was 9.7 grams the white cell count averaged 10,000. There were, of course, wide variations, the hemoglobin being as low as 4.5 grams, white count reaching 26,000.

Wounds It was not always possible at the time of admission to determine which wounds were "infected." In our earlier cases there was a tendency to postpone inspection of the wound as long as possible in order to avoid contamination. It was later realized however that the usual criteria—fever, rapid pulse, leukocytosis, and general appearance—were not always reliable indications of infection, especially infection due to gas-forming organisms. As our experience increased we tended to inspect the wounds earlier and upon slight suspicion. On the other hand it is conceded that wounds which appear superficially infected on initial inspection may heal without complication if undisturbed. We feel that the error of omission is the more serious. The average period before wound inspection was 4 days in the entire series, but the large number of immediate or 24 hour inspections was offset by one case in which the wound was not examined for 8 weeks. It was felt that once we could assure ourselves of the appearance of the wound and the adequacy of the débridement subsequent dressings could be kept at a minimum.

There were 2 instances of massive gas gangrene and 3 of gas cellulitis. Otherwise there were no patients with spreading soft tissue infections, invasive cellulitis, or lymphangitis. A large number of wounds contained superficial necrotic material, and many showed evidence of surface infection. A few wounds had been plugged with vaseline gauze and spreading infection was un-

doubtedly prevented by prompt removal with release of dammed up blood and exudate. The first inspection of the wound revealed evidence of deep abscess formation in 4 instances. Secretions from the wounds were not routinely cultured.

In wounds which had penetrated the knee joint there was a high incidence of infection. Of 8 such cases, 4 developed joint infection and these were the sickest patients of the group and the most difficult to treat.

We believe that early inspection of thigh and knee wounds following admission to a fixed installation is a good general principle if the initial toilet of the wound has been carried out elsewhere. Gas infection can be discovered at the earliest possible moment a secondary débridement can be done if the primary operation was inadequate deep soft tissue infection can be controlled by early drainage and the form of subsequent treatment can be more readily determined. Afterward if the wound is satisfactory minimal frequency of dressing is advisable.

Metallic foreign bodies were noted in the wounds by roentgenologic examination in 33 patients 40 per cent many of them multiple.

Fractures It has been a common observation that in gunshot fractures of the long bones there occurs very marked comminution and fragmentation but it is generally noted that the classical bone displacements do not occur. This series of cases however was rather consistent in demonstrating the typical displacements of the fragments. In the upper third the proximal fragment was commonly flexed abducted and externally rotated. In fractures of the middle of the shaft, there was usually a slight amount of flexion of the proximal fragment. The lower third fractures almost invariably presented posterior displacement of the lower fragment due to the pull of the gastrocnemii. Approximately 80 per cent of the fractures in this series were in poor position upon admission to the hospital. Since they were received relatively early this fact played little part in the ultimate results.

Associated injuries Circulatory embarrassment is one of the gravest causes for concern in the management of these patients. It is significant to note that in 9 cases, 11 per cent, there was evidence of impaired circulation of the extremity. Most of these occurred in nonpadded plasters and when the plaster was split constriction was noted usually at the calf. Except for 2 cases of gas gangrene which resulted in death the circulation returned to normal following the splitting of the plaster through its entire length. We found hypesthesia and hypalgesia to be the usual early

wire through the lower femur. Anterior angulation usually occurs; this can be promptly corrected by placing the wire through the tibia. There was evidence of widening of the knee joint as a result of tibial traction in only 2 cases (Fig. 1). The wounds in both of these patients were severely infected with no hope being held for subsequent joint motion.

The most difficult deformity to correct in lower femoral fractures was persistent posterior angulation. This often could not be overcome by flexion of the knee or by manipulation. It was found that, with the wire through the tibial tubercle, the hinge of the Pierson attachment at the fracture site instead of at the knee, and with both the line of traction and the tibia maintained in the horizontal position, the posterior angulation was readily corrected (Fig. 2). This was the only type of case in which the line of traction was not made parallel with the shaft of the femur. It is important to maintain a firm support beneath the site of posterior angulation. A well padded Cramer wire splint placed on mullin slings and bent to the desired curve readily serves the purpose. The area must be carefully watched for signs of pressure irritation.

In fractures of the middle and upper thirds, the wire was inserted through the lower femur at the junction of the shaft and condyles and halfway between the anterior and posterior surfaces. We feel that control of the lower fragment is best obtained by the lowest insertion of the wire that can be accomplished without penetrating the knee joint. Placing the wire through the femur has the added advantage of permitting knee joint function at an earlier date. In fractures of the proximal third, marked flexion and abduction of the thigh are usually required; in addition, external rotation may be necessary. Middle third fractures require very little thigh flexion. In cases with knee joint infection, flexion of the knee was limited to 5 degrees in order to avoid persistent flexion deformities.

Satisfactory length and alignment were obtained by these methods in almost every patient admitted within 3 weeks of the original injury. Only an occasional manipulation of the fragments under anesthesia was required.

When the wire had been inserted through the femur passive knee motion was begun at the end of 8 weeks. A rope and pulley arrangement was fastened to the end of the Pierson knee piece, and the patient was able to control the motion of his knee within the limits of comfort. Tibial traction cases obviously did not have knee motion until the wire was removed.

Skeletal traction was continued until there was roentgenologic evidence of bone union. Union occurred on an average in about 12 weeks. The wire was then removed and the patient maintained in suspension for an additional 2 weeks, during which time knee and hip motions were encouraged. Most of the American patients were immobilized in plaster at this point and sent by plane to the Zone of the Interior. The Chinese patients were kept in bed for an additional month and received daily massage and active and passive motions of the extremity. Quadriceps exercises were stressed from the beginning of treatment. Guarded weight bearing was permitted only after 18 weeks, but it was impossible to control many of the Chinese patients, some of whom began to walk at the end of the 14 week suspension period. Several refractures were the result of early weight bearing and these delayed convalescence considerably. No leg braces were available at this time.

There were remarkably few complications resulting from the wire traction. There were no soft tissue or bone infections at the site of the wires. Only one wire snapped, and this occurred at the end of 12 weeks traction. Three tibial wires pulled out into the soft tissues and had to be replaced. This accident was caused by too superficial insertion of the wire into the tibial tubercle. In one case the traction bow became loose from one end of the wire, and the wire was pulled out through the other side by the weights. This occurred at the end of 8 weeks, and there were no ill effects, further traction being unnecessary.

Residual stiffness of the knee was a problem in many cases. It is impossible to determine which cases will develop this stiffness; length of immobilization is not the only factor. Personal variation in the willingness of the patients to co-operate, their ability to tolerate discomfort and their desire to get well, are qualities of major importance. Early active and passive motion of the knee is certainly to be encouraged. Physical therapy must be regular and intensive. Gradually increasing manipulation of the knee by the physical therapist with the patient prone and the fracture site supported, was useful and did not produce any untoward results.

Forceful manipulation of the knee under anesthesia however was disappointing. Tears of the quadriceps mechanism were produced in 2 cases, which further delayed the patient's convalescence. Even when improvement in knee motion was obtained, it was always fleeting since increased postoperative discomfort militated against the patient's maintaining the increased range of



Fig 1 Widening of the knee joint due to traction through the tibial tubercle in a supracondylar fracture with septic arthritis.¹

motion. In several cases the result was a poorer functioning joint than before the manipulation.

Wedge plasters were more productive of beneficial results. In cases with limited flexion a circular plaster was applied from ankle to groin and muslin hinges were incorporated in the plaster on either side of the knee. An elliptical window was removed from the plaster behind the knee and a transverse incision was made in it anteriorly. Each day the anterior opening was enlarged by blocks of wood and the range of flexion gradually increased. Care was taken to extend the knee completely each day before increasing the wedge in order to avoid the possibility of ending with a knee which had increased flexion but could no longer be extended. In the reverse situation when there was limitation of extension with consequent faulty weight bearing wedge plasters were also helpful; the window being placed anterior to the knee and the joint gradually extended.

COMPLICATIONS

Thrombophlebitis. The diagnosis of thrombophlebitis was made in only 2 instances. One of the deaths was shown at autopsy to be due to a pulmonary embolus secondary to a thrombo-



Fig 2 a Marked posterior angulation of fracture of distal third of femur. Persistent deformity on Braun Boehler splint. b Satisfactory alignment obtained by placing joint of Pierson leg attachment under the fracture and making traction in the line of the tibia.

phlebitis of the pelvic veins on the side opposite the femoral fracture and associated with an osteomyelitis of the ilium. The other instance was diagnosed after the patient became ambulatory when swelling of the leg was noted and palpation revealed definite evidence of a thrombosed femoral vein.

Secondary hemorrhage. Secondary hemorrhage was noted in 4 instances, 5 per cent. One occurred 3 days after injury. At operation a popliteal artery which had been severed in battle was found. Gas gangrene not recognized previously was also discovered at operation and necessitated amputation. The patient died within 12 hours probably from toxemia since blood loss was minimal. Two cases had wounds involving the femoral artery which bled 6 and 10 weeks respectively after injury. In both cases the artery was ligated and satisfactory collateral circulation was established. The last patient of this group did not bleed until 16 weeks following injury. At operation a false aneurysm of the femoral artery was found. This was repaired but subsequent amputation below the knee was required because of deficient circulation. It is interesting to note that in all 4 patients the ankle pulses were palpable on admission and that the circulation at that time seemed adequate. Secondary hemor-



Fig. 3. a, left, Comminuted fracture of middle third of femur with multiple metallic fragments. b, Same case at 3 weeks. Typical example of low grade localized osteomyelitis with sequestrum.

riage was always considered an absolute indication for immediate exploration of the wound.

Refraction. In 6 patients 7 per cent refraction occurred usually following some minor trauma. One developed while the patient was still in traction during an epileptic seizure. These patients were treated either by plaster fixation or reapplication of wire traction. Five of them obtained eventual bone union and the sixth was returned to the Zone of the Interior before this could be determined. Of the 6 refractions, 5 were in patients having definite bone infection. We feel that we erred in applying the same criteria for length of immobilization in the bone infection cases as in the clean cases. The former should have been given a longer period of fixation. The



Fig. 5. a, left, Early film of severely comminuted fracture with marked bone loss. b, Film taken 9 months later shows solid bone union.

use of leg braces might have prevented some refractions, but they were not then available.

Bone infection. Bone infection of some degree developed in 23 patients, 28 per cent. Unless associated with septic arthritis of the knee this was not a difficult problem. Bone union eventually occurred in all but one who had massive bone loss. His case is discussed later. Of the 22 remaining cases only 2 showed significant delay in bone healing as shown roentgenologically.

With one exception which was diagnosed by persistent drainage and the operative removal of a sequestrum these cases showed x ray evidence of localized osteomyelitis. The films did not reveal in any instance a spreading type of bone infection. In no case did a metastatic abscess develop. Figure 3 is a typical example of the minimal type of bone infection which was encountered. It is possible that the local and general use of the sulfonamides has modified the course of the bone infection as shown clinically and by films surely no very serious infection was observed.

The only operative procedure which was, we considered, indicated in these bone infections was incision and drainage, with or without sequestrectomy. Often this was done in the ward with the patient still in traction, usually under pentothal anesthesia. Posterior drainage by counter incision is very important, and the possibility of gravitational abscess must be kept in mind.

A draining sinus was the only persistent abnormality in this group. Sometimes it remained as



Fig. 4. Nonunion due to very marked loss of bone.

long as 10 months and it is certain that some of these patients will require further surgery.

We have analyzed the various factors which might conceivably influence the occurrence of infection. Among these factors are anemia, the presence of metallic foreign bodies, the interval which elapsed between injury and débridement, and coincident penetration of the knee joint. As almost all patients had débridement and sulfonamide therapy it was difficult to assess their value in the prevention of infection except by impression. When the other factors are tabulated it is found that, with two exceptions, there is no significant difference between the cases in which infection developed and those in which it did not. The average hemoglobin level on admission was 11 grams in the cases which remained free of infection and 7 grams in the infected cases. This emphasizes the importance of early replacement of blood loss by whole blood transfusions. Second, when the fracture communicated with the knee joint the likelihood of bone infection was increased threefold. It is our belief that the adequacy of the débridement is the most important single factor in the prevention of infection. It would appear from our data that the golden period for débridement has been extended by the use of the sulfonamides, since we found the incidence of infection in the patients débrided less than 12 hours almost identical with those débrided more than 12 hours.

Septicemia. In all cases with prolonged febrile course or severe toxicity blood cultures were taken, but in none was there evidence of septicemia. In none could the diagnosis be made on clinical grounds.

RESULTS

Mortality. There were 4 deaths in the group, an overall mortality of 4.9 per cent (Table I). Two were from diseases not directly related to the fractured femurs. One patient was found on admission to be suffering from a severe dysentery and died from peritonitis secondary to perforation of ulceration in the colon of unproved etiology. At autopsy no infection at the fracture site was found. The other died of pulmonary embolism following a sequestrectomy done for osteomyelitis of the pelvis on the side opposite the femoral fracture. The 2 remaining patients died of gas gangrene. Both of these had amputations which were performed too late. Earlier operations might have saved both lives. One arrived in a plaster spica 2 days after injury. The seriousness of the infection was not recognized until 24 hours later when a mild secondary hemorrhage demanded exploration of the wound. The other

TABLE I.—RESULTS

	No.	Per cent
1. Mortality		
a. Pulmonary Embolism	1	
b. Bowel perforation	1	
c. Gas gangrene	2	
Total	4	4.9
2. Amputations		
a. Gas gangrene	2	
b. Arterial injury	1	
Total	3	3.7
3. Bone union (of 74 cases)	71	96
4. Functional results (of 67 cases)		
a. Good	45	67
b. Fair	16	24
c. Poor	6	9
5. Cause of results other than good		
a. Stiff joint		
Hip	2	
Knee	9	
Total	11	
b. Shortening and angulation	4	
c. Nonunion	3	
d. Sciatic nerve injury	4	

arrived 7 days following a perforating bullet wound which had not been débrided. A transfusion given in preparation for operation resulted in a severe hemolytic reaction with chill, prolonged hypotension and subsequent jaundice, hemoglobinuria, and oliguria. The only chance for saving this patient was lost by waiting for recovery from this reaction rather than operating immediately. When operation was performed 4 days after admission, he was in such poor condition that the result was inevitable: blood transfusion should have been used as an adjunct to operation rather than preparation for it.

Amputations. Two of our 3 amputations were performed because of gas gangrene. The third followed repair of a false aneurysm of the femoral artery. The latter patient made an otherwise uneventful recovery.

Bone union. Of the 78 patients who lived there was one amputation, and 3 patients were transported to the Zone of the Interior before the end results could be determined. Of the 74 remaining cases, 71 or 96 per cent showed clinical and roentgenologic evidence of bone union. Two cases of nonunion had massive loss of bone (Fig. 4). In the other instance, a clean case, the cause was unexplained. While the great majority of fractures united in from 12 to 14 weeks, some were observed for 8 to 10 months before we were satisfied that union was secure. There was surprisingly satisfactory union in several cases with marked bone loss (Fig. 5).

Functional results. American patients were returned to the States too early to judge the

functional results. The Chinese however were kept in the hospital long enough for us to estimate with reasonable accuracy their degree of functional recovery. There were 3 deaths in this group and, of the 67 remaining patients, 45 or 67 per cent, had good functional results. In 16 or 24 per cent the result was only fair and in 6 or 9 per cent it was definitely poor.

The chief cause of unsatisfactory results was residual stiffness of the joints, especially the knee. There were 11 such cases. Shortening angulation and nonunion accounted for an additional 7 cases, and 4 patients had sciatic nerve injury.

SUMMARY OF IMPORTANT POINTS

An intensive study of 82 gunshot fractures of the femoral shaft incurred in action in the North Burma campaign of 1943-1944 revealed the following points worthy of emphasis:

1. The function of the forward surgical groups is the treatment of shock and hemorrhage, adequate débridement of wounds, institution of prophylactic chemotherapy, immobilization of fractures, and early evacuation. Definitive treatment of fractures should be reserved for the fixed installations.

2. In the prevention of infection the most important single factor in the early treatment of wounds is the adequacy of the débridement.

3. A spica plaster is a satisfactory method of temporary immobilization. Nonpadded plasters should not be used but if used by necessity, they should be split through their entire length before transportation.

4. No ankle or instep hitches should be used in connection with Army leg splints.

5. Early inspection of the wound at the fixed medical installation is advisable to rule out infection, especially by gas-forming organisms. Afterward dressings should be reduced to a minimum.

6. Incision and drainage should be instituted early when there are knee joint infections or deep subfascial abscesses. Dependent counter-incisions are necessary.

7. Circulatory impairment is serious and not uncommon. It must be recognized early and the cause eliminated.

8. Anemia, malnutrition, and the effects of exposure must be combatted. Early replacement of blood loss by whole blood transfusion improves the general condition of the patient and helps to prevent infection.

9. Balanced skeletal traction suspension is a very satisfactory method of treating these patients in a fixed installation.

10. When traction suspension is used, the possibility of gravitational abscesses should be watched for and early drainage should be accomplished.

11. Kirschner wires through the lower femur and upper tibia proved very satisfactory and there were no untoward effects. Each location has its advantages for certain types of fracture. The wires should be changed from one location to another when indicated.

12. Posterior angulation of lower femoral fractures can be corrected by placing the wire through the tibial tubercle and making traction in the line of the tibia instead of the femur.

13. Repeated roentgenologic examination is essential in treating these cases by traction suspension. Overpull must be avoided.

14. When there is associated knee joint infection, flexion of the patient's knee in the traction suspension apparatus should be limited to 5 degrees.

15. Traction should be continued until there is roentgenologic evidence of bone union. The average time for bone union was 12 weeks. Knee joint motion should be encouraged after 8 weeks.

16. Forceful manipulation of the knee is of no value and may do harm. Wedge plasters, however, are of considerable assistance in the relief of persistent joint stiffness.

17. Secondary hemorrhage from a wound, however slight is a positive indication for immediate exploration.

18. Refractures usually heal but convalescence is considerably prolonged thereby. Patients with precarious union should be kept in suspension for an added length of time. Afterward leg braces should be used when they are available.

19. Bone infection did not predispose to nonunion, nor did it significantly delay the time of bone union as seen on the roentgenograms. However, refracture in these cases must be avoided by a longer period of immobilization than in the clean cases.

20. The osteomyelitis seen in our cases was localized, minimal, and easily controlled. It is possible that it was limited by the use of sulfonamides.

21. Retained metallic foreign bodies did not appear to predispose to bone infection.

22. There was a mortality of 4.9 per cent. Bone infection of some degree was noted in 28 per cent. Bone union occurred in 96 per cent of the survivors. The known functional end-results of 67 followed cases were good in 67 per cent, fair in 24 per cent and poor in 9 per cent.

THE DIAGNOSIS OF ACUTE FLEXOR TENDON TENOSYNOVITIS

WILLIAM R. MOSES, M.D., Washington, D.C.

THE greatest difficulty in the care of infections of the hand is the diagnosis and differentiation of the types. This statement was made by Kanavel who also remarks concerning tenosynovitis, "This type of infection is much more difficult to recognize (than lymphangitis) and the surgeon is often in doubt as to whether he is dealing with a lymphangitis or a tenosynovitis. He might well have added or both."

Thus does one of the fathers of hand surgery express the uncertainty of exact diagnosis in many cases of these grave infections. However the correct treatment of tenosynovitis is surgically the exact opposite of that of simple lymphangitis and allied conditions of the hand therefore an exact diagnosis must nonetheless be made. If the indifferent results so often attending the care of these infections are to be improved, irreparable damage is the penalty for late or faulty diagnosis.

As outlined by Kanavel, the cardinal signs and symptoms of acute tenosynovitis are (1) exquisite tenderness over the course of the sheath limited to its distribution (2) the semiflexed attitude of the finger (3) exquisite pain on extension and (4) symmetrical swelling of the entire finger.

Several difficulties, however, may and do detract from the specificity of this syndrome. An analysis of these signs reveals that they are not pathognomonic either singly or in combination. This may be demonstrated clinically by experience or by logical scrutiny. The first sign of tenderness limited to the sheath is camouflaged by the frequent association of tenosynovitis with such additional lesions as dermatitis, cellulitis, lymphangitis, burn or other trauma or hematoma. Furthermore, there is an occasional case encountered in which only a part of the sheath is involved as mentioned by Cutler. Second the semiflexed attitude is that adopted by patients with any acute disease of the finger because this is the position of rest for the part. Third the pain on extension is as characteristic of cellulitis or lymphangitis as of tenosynovitis because either flexion or extension of the digit will result in a distinct distortion of the soft parts including pain.

From the Surgical Service of the Gallinger Municipal Hospital.



Fig. 1. Actual flexion of involved finger is prevented by the engagement of the nail of the finger in the thumb nail of the examiner. Attempted flexion produces pain along the palmar aspect of the finger in the presence of acute tendon sheath infection.

when these are tender. Finally, symmetrical swelling is found usually in simple lymphangitis.

There remains, however, a method of examination which is a more direct approach to the tendon sheath. This test may be practiced in the following manner as illustrated. The nail of the involved finger is engaged in the thumb nail of the examiner in such a manner that actual flexion (and thereby compression of the soft tissues) is not allowed. The patient is then asked to attempt flexion of the member. It will be seen in the accompanying photograph that the examiner's forefinger may be used to steady the dorsum of the finger. In the presence of acute tendon sheath infection, acute pain is experienced along the palmar aspect of the finger due to the bowstring like tensing of the tendon against its sheath. Pain is consistently absent in infections involving the soft parts alone.

The author has used this test of differentiation in 23 consecutive cases of acute tenosynovitis, simple and complicated by other lesions as above mentioned. It appears to be a specific test.

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A. D. Ballou

EDITORIALS

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ALBERT D. BALLOU AN APPRECIATION

THE initial issue of SURGERY GYNECOLOGY AND OBSTETRICS was published on July 1, 1905 with 600 paid subscriptions registered and a leading article written by Nicholas Senn. The trials and tribulations of the initial issue of the Journal have been written by Dr. Franklin Martin. As the Journal increased in popularity and number of subscribers it became certain that a man with a knowledge of printing and bookmaking must be chosen as General Manager. Many young men applied for the position, Albert D. Ballou was chosen. This was in 1907.

Educated in Iowa, the son of a Methodist minister and trained for a career in journalism, Mr. Ballou has occupied the position of General Manager of the Surgical Publishing Company of Chicago for the past 38 years. His modesty, loyalty, business sagacity and ability to build an organization which has been welded together through the years by a spirit of friendliness, co-operation, and mutual

respect have played a large rôle in the success of the Journal. He and his associates have been completely responsible for the format of the Journal, its attractive appearance and the high standards of its advertising material. The wisdom of his judgment and the clearness of his vision are reflected in its pages.

To Mr. Ballou Dr. Martin gave the task of organizing the mechanics of the first Clinical Congress of Surgeons in 1910. With each succeeding Clinical Congress, even after it became a part of the activities of the American College of Surgeons in 1913, he has discharged his responsibilities with great credit to himself and to the College of Surgeons. His meticulous fulfillment of tasks given to him, regardless of their magnitude or their relation to his primary responsibility, has always enlisted the profound admiration of his colleagues. Few laymen have such an extensive friendship among the surgical profession as he has.

The Board of Regents of the American College of Surgeons and the Board of Directors of the Surgical Publishing Company, as the time approached for his retirement, desired to record their appreciation of his invaluable service and to congratulate themselves upon the fact that his judgment and advice will still be available to them. It is their hope that the esteem and regard in which they hold him and their deep appreciation of a task of great magnitude well done will give added pleasure to his enjoyment of the future.

Irvin Abell

Chairman, Board of Regents, American College of Surgeons
Chairman, Board of Directors, The Surgical Publishing Company of Chicago

STRICTURES OF THE COMMON DUCT

STRICTURES of the common duct have always been a great problem to surgeons because results of repair have been so poor and their causation is usually related to an operation on the bile tract. In a study of patients with stricture Cattell noted a relationship to operative trauma in about 80 per cent of cases and Walters in 90 per cent of cases. In a study made recently at Illinois Research Hospital such a relationship was present in 76 per cent of cases.¹

It is no doubt true that in many instances the damage may have been done by infection or an abscess and not by actual trauma. Nevertheless there are so many instances in which actual section or ligation of the duct can be proved that it behooves all surgeons working on the biliary tract to take extra precautions for safety of the ducts during operation upon the biliary system.

From the standpoint of treatment the lesions can be divided into four major groups (1) local stricture which can be resected with primary anastomosis (2) stricture of the terminal end only allowing transplantation of the proximal stump into the pylorus or duodenum (3) stricture of the proximal portion allowing preservation of the sphincter of Oddi and (4) destruction or stricture of the entire duct. Repair of the first two types is comparatively simple and results will be good if certain pitfalls are avoided. For example in group 1 it is desirable to do the anastomosis over a rubber or vitallium tube but if a T tube is used it must not be brought out through the repair line but through an incision in the duct distal to it. In group 2 reformation of a stricture will be prevented to a great extent if

the mucosa of the common duct is anastomosed directly to the mucosa of the intestine (Cattell). In groups 3 and 4 the vitallium tube as introduced by Pearse can be used to advantage. Search should always be made for the distal end of the common duct since the sphincter of Oddi is such a valuable factor in prevention of regurgitation of intestinal contents into the bile ducts. It is difficult to explain the mechanism of production of the stricture in group 4 and particularly the high frequency of this type. We have been unfortunate in finding an unusually large incidence of this type at Illinois Research Hospital, encountering this type in over half of 24 cases of inflammatory or traumatic stricture. If search is thorough one can usually find the terminal duct or its remnant. We have not found incision into the duodenum for visualization of the sphincter of Oddi to be of much value to us. In almost all of our cases in group 4 we have found either a duct too small for function or one entirely obliterated. In view of multiple observation on a few cases, we are convinced that this obliteration can be gradual and can be produced by infection and disuse.

Because of the frequency and difficulty in repair of group 4 we have devoted most of our attention to this group. We have tried anastomosis to the duodenum or pylorus of the stump of the duct at the hilus of the liver with so many failures that we have abandoned it. All patients repaired after this fashion do well for 6 months to 2 years, but ultimately all except one or two of ours have returned with serious symptoms of recurrence of the stricture.

For this reason we began the use of a vitallium tube to bridge the defect but did not think it would be feasible to transplant the tube into a loop of intestine which was functioning theoretically the food stream would

¹Cole, W. H., Treason, Carl, and Reynolds, John. *Ann. Surg.* (in press).

dislodge the tube. We accordingly adopted the principle of anchoring the tube to the stump of the duct at the hilus of the liver with a pursestring suture, and inserting the tube into a defunctionalized loop of jejunum. In 5 cases we inserted the tube into a loop of jejunum, the arms of which were anastomosed hoping to shunt the food away from the tube thus minimizing possibility of regurgitation of food and intestinal contents into the intrahepatic ducts. To our surprise in the 4 patients who survived this operation, the food stream continued to flow through the arm of jejunum. All 4 patients developed cholangitis with chills and fever which was fatal to one. Two of the three remaining had the proximal arm of jejunum severed and valves made in the distal arm. These two patients have had complete freedom from chills and fever, indicating that regurgitation of food was the primary cause of cholangitis.

Having had poor results with the use of a loop of jejunum we later adopted the use of a defunctionalized arm of jejunum utilizing the Roux principle. We have operated on 7 patients after this technique. This method is similar to one recently reported by Allen except that he used a rubber catheter instead of a vitallium tube and made no valves to prevent regurgitation. All 7 patients survived this operation but one died 2 years after operation with Banti's disease, which we assume to be entirely coincidental. All 6 patients surviving have had excellent results 2 or 3 of them having had one or two mild chills early in their convalescence.

We obtained such definite evidence of the rôle of regurgitation of food into the intrahepatic ducts in the development of cholangitis that we have arrived at the conclusion that 2 or 3 valves created by infolding of the intestinal wall (or equivalent method) should be placed in the arm of jejunum to prevent

regurgitation and that at least 18 inches of jejunum should intervene between the anastomosis at the hilus of the liver and the end to side anastomosis of the jejunum.

On two occasions x ray observation at intervals has revealed passage of the vitallium tube after a few months. However, both of these patients have remained entirely well. In these cases at least the value of the tube could have been nothing more than temporary. Nevertheless we are convinced that a temporary support of some type is absolutely essential for a few weeks, to maintain an opening and prevent shrinkage or possibly a true stricture at the junction of the hilus and arm of jejunum. It appears logical to assume that if the opening was small or stricture formation developed the tube could not pass on account of the flange and funnel shaped tip. On the other hand after the sutures had cut through (which we assume would happen in a few weeks with release of the tube) the tube might be passed if the opening was large enough to allow passage of the flange and funnel shaped end. If the opening is this large after the process of healing and scarring has been complete the chance of stricture formation would appear minimal indeed. For this reason we believe that if the tube remains in place for 3 months it makes no difference whether it remains or passes, since the opening would appear sufficiently large to avoid stricture formation if large enough to allow passage of the tube after that interval. WARREN H. COLE

INTRAVENOUS AMINO ACIDS, PROTEIN DIGESTS—ACCURACY OF TERMINOLOGY

THE intravenous injection of nitrogenous substances for nutritional purposes has received widespread attention in the past several years. It is to the credit of surgeons that as a group they have

played a prominent rôle in the development of this field which is more closely related to the fundamental sciences than to clinical surgery.

In the literature concerning the practical application of intravenous nutrition with nitrogenous materials the terms "amino acids" and "casein" or "protein digests" seem to have been employed interchangeably. This is confusing especially to the chemists. A solution of amino acids is just that and is prepared by addition of these acids each in crystalline form obtained synthetically or by extraction. A protein may be decomposed to its constituent amino acids but the writer is unaware of a digest generally available at this time in which this has been accomplished. The several types of available digests represent mixtures of simple peptides and amino acids. It has not yet been demonstrated that utilization of intravenously administered digests and solu-

tions containing only amino acids are identical phenomena. Indeed it has not yet been determined which type of preparation is the most desirable.

Now that the general principles have been established, it falls to the chemists further to improve nitrogenous nutriment for intravenous use. In doing this they must take cognizance of clinical research with the several types of solutions employed. In the interests of accuracy and to facilitate a general agreement in the manner of recording experiences, the consistent use of "casein," "fibrin," and similar terms, "digest" should be employed where such solutions have been used. The term "amino acid solutions" should be reserved for solutions composed of these acids only. The terms mentioned should not be employed indiscriminately as they refer to different preparations. ALEXANDER BRUNSCHWIG

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

THE third edition of *Titus Management of Obstetric Difficulties*¹ like the first two editions is not intended as a conventional textbook. However it has been made more complete particular ly as regards an extensive bibliography. The emphasis on the practical nevertheless has been maintained and its aim as a working aid in dealing with obstetric emergencies preserved. Additions and changes have been made so as to bring this third edition grossly up to date. For example the Rh factor and erythroblastosis are thoroughly discussed, caudal analgesia is included in the chapter on anesthesia, the tech niques of extraperitoneal cesarean section are nicely described and illustrated and penicillin therapy is completely discussed in practical detail.

Because it covers mainly the abnormal phases of obstetrics, minimizing historical and therapeutic considerations and because it presents in a straight forward manner the practical aspects in the treat ment of these abnormal phases it should be avail able to all who may be faced with obstetric difficulties in practice or in training. It is of unlimited value to the general practitioner and to the obstetric house officer or resident. During my own hospital training the previous editions of this text were of the greatest aid, particularly in emergencies where a quick reference was needed. The author has expressly in tended this book to serve just such a purpose, consequently, he has avoided lengthy discussions of all the possible forms of therapy in any given situa tion, and has frankly expressed his own preferences which are based upon years of clinical experience and which are nearly universally acceptable. This book is a must.

STUART ABEL.

THE fourth edition of *Essentials of Body Mechan ics in Health and Disease*² by Goldthwait Brown Swaim, and Kuhns has decreased in size but has become more compact and concise while still retain ing its clarity. The book is more timely now than ever since there is so much stress on physical fitness nationally. The great number of rejections that oc curred in Selective Service showed the necessity for more stress on physical fitness throughout the country. The need for rehabilitation of the return ing service men, as well as the great problem of cor recting so many of the deformities and disabilities seen in civilians make this book of importance in

this connection also. Many of the deformities in adult life could be prevented by establishing good body mechanics in childhood.

The advantage to the individual with chronic illnesses in the correction of body mechanics is demonstrated in several chapters of the book. In this connection the work of Kerr showing the rela tionship of the heart and circulation to body me chanics is particularly interesting. The importance of keeping the aged in good physical condition which will improve their general well being is greater since the life expectancy has been definitely increased.

The chapter on the foot has been rewritten. The most common static deformity pes valgoplanus is conceived of as being a congenital defect in many instances, with the second toe longer than the first and the mechanism at the great toe more pliable than normal. The treatment described is by means of a series of exercises for the foot, in sitting and stand ing positions. To protect the weak foot, arch sup ports are recommended.

EMIL D. W. HAUSER.

A timely contribution to an important branch of surgery especially under war time conditions is Armstrong's *Bone Grafting, in the Treatment of Fractures*³.

The author a meticulous worker has excellent qualifications from the viewpoints of training as signment, experience and associations.

The value of bone-grafting in the treatment of fractures is well known. In the practice of this particular branch of orthopedic surgery one in evitably is confronted by many problems and prac tical difficulties. This book has arisen out of the difficulties the author has encountered.

In the foreword Mr. Watson Jones states that the principles of bone grafting were familiar to John Hunter two hundred years ago. He further states:

In his monograph of bone-grafting in the treat ment of fractures Mr. Armstrong's work reflects the surgical development of two hundred years—the research of Hunter, the work of Lister the in spiration of MacEwen, the skill of Lane and the craftsmanship of Albee. On this very sure foundation linked to recent research in metallurgy is based a technique of bone-grafting which almost completely solves the problem of slow union, delayed union and non-union. Mr. Armstrong has dealt faithfully with every detail of technique that the surgeon must know. As a leading member of the team of ortho-

¹BONE GRAFTING IN THE TREATMENT OF FRACTURES. By J. R. ARMSTRONG, M.D., M.Ch., F.R.C.S. Baltimore: The Williams & Wilkins Co., 1935.

²MANAGEMENT OF OBSTETRIC DIFFICULTIES. By Paul THOM, M.D. of St. Louis. The C. V. Mosby Co., 1945.
³ESSENTIALS OF BODY MECHANICS IN HEALTH AND DISEASE. By Goldthwait BROWN SWAIM, M.D., F.A.C.S., and Lloyd T. BROWN, M.D., F.A.C.S. Loring T. Swaim, M.D. John G. Kuhns, M.D., F.A.C.S. Philadelphia: J. B. Lippincott Co., 1945.

pedic surgeons of which the Royal Air Force is proud surgeons who have shouldered heavy responsibility, he with them has gained vast experience and treated the fractures of pilots and aircrews which are characterized by remarkable severity and multiplicity. In all their work the highest possible standard has been set, and it has been maintained by the vigilance of Osmond Clarke, a service consultant. But it has been achieved without standardization or suppression of initiative.

The technique of onlay bone-grafting with vital Hum screw fixation is well established. Brilliant results can be achieved—deformity can be prevented, union can be accelerated, nonunion can be avoided. But, let it be remembered that John Hunter was defeated by sepsis. Let it be remembered that internal fixation was no more than part of the contribution made by Arbuthnot Lane; no-touch technique was the other part. Even today the general standard of asepsis in operative technique is far too low. To infect a closed fracture is a disaster of the first magnitude; it is no less worthy of a court of inquiry than a railway disaster. The surgeon who proposes to adopt the recommendations of Armstrong's monograph must first achieve so perfect a command of aseptic technique that if, within a few days of operation, the patient develops a febrile reaction he can say with complete confidence: "He may have pleurisy, he may have pneumonia, but whatever he has, I am quite certain that he has no infection in the wound."

Armstrong believes that the onlay graft technique is the simplest and most efficient. The most effective available grafts are those cut from a normal tibia. The use of metal screws is the most reliable method of securing internal fixation.

He outlines certain basic considerations such as close and stable contact between large areas of raw bone on the graft and host; mechanically stable fixation of the graft and fracture; before grafting, the clearing of the fractured surfaces of fibrous tissue and sclerotic tissue; restoration of normal apposition and alignment of the fragments of the host bone. The architecture of the reconstructed bone as a whole should as far as possible at the conclusion of operation approximate normal.

Subjects discussed are the principles, general indications, contraindications, types, sources and fixation of grafts; preoperative and postoperative treatment; operative technique; cutting and preparation of grafts; fractures of the spine, clavicle, humerus, radius, ulna, carpal scaphoid, metacarpals and phalanges, neck of the femur, shaft of the femur, tibia, fibula, ankle, tarsus and metatarsals.

Arthrodesis has been discussed in connection with certain fractures of the tarsus and spine in which he believes it to be the best initial treatment.

Most of the roentgenograms and the statistics included in the Appendix were taken from the records of the Royal Air Force orthopedic centers. The author acknowledges the debt which he in common with all the other orthopedic surgeons in

the Royal Air Force owe to Mr. Watson-Jones and to Air Commodore Osmond Clarke. He pays tribute to every member of the orthopedic "team" in the center to which he is attached.

Those who will receive the greatest benefit from this book are the surgeons who have (1) the qualifications to do this type of work, (2) the interest, (3) the opportunity, and (4) adequate facilities to do it well, including physical set up, medical, surgical and allied personnel and equipment.

Minor criticism includes the thought that the double onlay graft has not been given sufficient space and illustration. Some of the colored illustrations are too highly colored. Some photographs are only fair-line drawings would have been more instructive. However, in spite of these criticisms, the book can be recommended without reservation.

PHILIP LEWIS.

A CONCISE presentation is made in *Hypertension and Hypertensive Disease* of the authors' concepts of hypertension and hypertensive disease with a critical analysis, almost approaching dogmatism, of many existing ideas on the genesis and management of these disorders. The material is well presented with considerable space devoted to functional evaluation and its bearing on the rationale of certain forms of therapy.

In the early chapters hypertension is defined and hypertensive disease is discussed. The authors consider essential hypertension as an indefinable physiologic disturbance (or disturbances) characteristic of this disease which ultimately leads to elevation of diastolic and systolic blood pressures, anatomical changes in the vascular tree, and functional impairment of the involved tissues. They feel that in the past physicians have been too interested in the level of the blood pressure and have neglected the primary cause. After considering the factors capable of altering blood pressure, they conclude that the responsible agent is a generalized vasoconstriction sufficient to increase the total effective peripheral resistance. The authors tend to show that although a humoral mechanism with a superimposed neurogenic factor is generally believed to cause vasoconstriction, controversial data exist which prevent this concept from being a reality.

This section is followed by a critical analysis of the renal mechanism in the genesis of human hypertension. They oppose the inference that experimental (induced) and human (spontaneous) hypertension are the same. Their conclusions are based on a detailed analysis of the cases in the literature in which bilateral and unilateral intrinsic renal disease in humans was considered the primary mechanism. By their own strict criteria a rare instance was allowed but the majority of cases were not accepted. Renal ischemia was also eliminated as the cause for hypertension in pregnancy.

HYPERTENSION AND HYPERTENSIVE DISEASE. By William Goldring, M.D. and Herbert Chown, M.D. New York: The Commonwealth Fund, 1944.

The chapter on the evaluation of the current medical and surgical treatment is too critical as the authors' criteria for evidence of cure is rigid and almost impossible so long as the cause of hypertension remains unknown. Anything which merely depresses the blood pressure is considered artificial when no attempt is made to combat the cause. Thiocyanate therapy was not recommended as it proved dangerous in their hands. They admitted that pyrogenic substances lowered the blood pressure but this was offset by the undesirable effects upon cardiovascular dynamics. Renal extracts were considered empirical, inasmuch as the authors believed that the fall in pressure resulting from their administration was probably associated with a pyrogenic reaction. Nephrectomy was definitely condemned. The newer concepts of amine-oxidase treatment were described.

The reader however is given some ideas as to treatment for a regimen is suggested which is conservative and logical. The management of hypertensive complications especially in pregnancy are worthy of comment.

Appendices are included at the end of the book which describe the technique of determining direct blood pressure measurements, cardiac output, and the various procedures used for determining renal function.

TERENCE R. VAN DELLEN.

THE author of the volume, *Radiologic Examination of the Small Intestine*, because of his scientific interest and tremendous experience, is one of the few qualified to deal with this important subject. Much of the material has been presented at instructional courses at the meetings of the American Roentgen Ray Society and the Radiological Society of North America. Those of us who have had an opportunity to attend these courses are indeed grateful that the author provided the profession with this fundamental material in the form of a book for study reference and reflection.

It has only been in comparatively recent years that any time or consideration has been given to the small intestine during a gastrointestinal examination. In most books published on the subject of the gastrointestinal tract little space is devoted to the small bowel. The author has had a wide experience in this field and has made every effort to correlate the roentgen with clinical, operative and postmortem observations. A thorough knowledge of the anatomy and physiology is paramount if one is properly to evaluate the roentgen findings and to differentiate the normal from the abnormal.

The author in his usual clear, concise, easily readable, and scientific manner devotes the first chapter to indications for roentgen examination technique, and the report of the small intestine study followed by a thorough description of the embryology, anatomy and physiology of the small bowel. He then describes the appearance of the normal small bowel

in the adult and the infant. Subsequent chapters are devoted to organic lesions such as intestinal obstruction the use of the Miller Abbott tube in the diagnosis and treatment of ileus disorders of nutrition, diseases of the mesentery, allergy, inflammations, neoplasms, anomalies, the effect of food and certain drugs on the small intestine and miscellaneous conditions. All of these conditions are discussed thoroughly with due credit given to the work of other investigators. The subject matter is well illustrated with excellent reproductions in the negative phase. An extensive bibliography is a further testimonial to the author's scientific approach to the subject.

This volume written by a man well qualified and completely familiar with the subject represents a truly outstanding contribution to the literature in the field of roentgenology. It should be in the library of every roentgenologist and any physician interested in the diagnosis of lesions of the intestinal tract. The publishers are to be congratulated on the excellence of the paper, the printing and the illustrations. It is recommended without reservation.

EARL E. BARTH

THE second edition of *Clinical Roentgenology of the Digestive Tract* by Maurice Feldman, which presents a clinical roentgenological consideration of diseases of the gastrointestinal tract has been thoroughly revised and completely reset. The importance of the diagnostic value of the roentgen examination is stressed throughout. The subject is handled in a lucid, concise manner well illustrated with excellent reproductions of roentgenograms and artists' drawings.

Separate chapters are devoted to the esophagus, stomach, duodenum, small intestine, colon, hernia, diaphragm, appendix, gall bladder, biliary ducts, liver, pancreas, peritoneum, omentum, mesentery and retroperitoneal tumors, lymphomatous diseases, abdominal vessels, spleen, the deficiency diseases and miscellaneous conditions. A systematic co-ordination and correlation of the clinical and roentgenological findings is emphasized in the discussion of every condition. The more recently described developments and methods of x-ray examination have been added. A complete bibliography is provided at the end of each chapter.

The author is to be congratulated for assembling such a vast amount of material into a single volume thus providing a source of accurate information on this important subject. The reviewer has found the first edition published in 1938 to be one of the most useful books in his library as an atlas for the medical students and as a helpful reference work providing a valuable and ready source of accurate information. The second edition is recommended without reservation to roentgenologists, gastroenterologists, students and general practitioners. The book should be added to the library of any physician

Interested in the accurate diagnosis of lesions of the gastrointestinal tract
Earl E. Burne

In simple, concise words the author's forty years of experience and teaching in the field of traumatic surgery is skillfully described in *Clinical Traumatic Surgery*. The valuable material in Dr. Moorhead's earlier books—*Traumatic Surgery* in 1917 and *Traumatic Therapy* in 1931—has been included and brought up-to-date by the excellent appraisal and discussion of improvements in the treatment of the injured. Chemotherapy and penicillin, early mobilization, Roger Ankerston reduction apparatus and Stader splints as well as many other advances are considered. This work is unusually well illustrated by photograph, diagrammatic sketches, many describing stages of treatment procedures such as reduction of the dislocated hip or the dislocated shoulder. The reproductions of x-ray films are not only excellently chosen but the reader can actually see the path logical condition described.

The 32 chapters covering 725 pages with 500 illustrations divide the field of traumatic surgery into logical categories in which the reader can quickly learn exactly where to find any particular type of traumatic problem discussed. The chapters on traumatic neurones, medicolegal phases of trauma, compensation problem and malpractice suits reveal the author's knowledge of the importance of these subjects in all traumatic surgery treatment. The chapter on war injuries is a fine abbreviated résumé of treatment of war injuries including much of the author's experience at the Pearl Harbor attack December 7, 1941 where he just happened to be at that time. One would expect Dr. John J. Moorhead to dedicate this book to "The Wounded at Pearl Harbor—In recognition of their courage and stamina and in tribute to their surgeon-comrades."

This book offers an excellent opportunity for the physician on duty in hospital receiving and examining room to study this field and should be there for ready reference. It should also be in every industrial medical department and dispensary for treatment of the injured. Since the general practitioner may occasionally or frequently be called upon to treat cases of injury, the volume offers an excellent ready source of reliable information.

One gains the impression of overcrowding of the pages necessitated by publication of this book under war time restrictions. Future editions that are certain to flow quickly I am sure will correct this condition where for example a new chapter follows the preceding chapter within an inch or two of the bottom of the page.

EDWARD C. HOLMES

Illustrations two in color, considerably broader in its scope than the title suggests. It is excellently written for the enlightenment of neurosurgical internes and young residents. From this standpoint it fulfills its mission well. The older neurosurgeons will find much of interest whether or not they agree on minor details as the book reflects the mature opinion of one of the pioneers in this comparatively new specialty. However the chief function of this work is the instruction of the novice. It is filled with simple truths, common sense observations and what to the experienced neurosurgeon may seem trivial or self-evident facts but which to the young man without such a background are valuable directives.

These are the simple instructions presented, knowledge of which we usually take for granted and cannot understand why the inexperienced fail to make the necessary observations and carry out the indicated procedures. Sachs anticipates the many simple complications which may arise before, during, or after a neurosurgical operation and gives detailed instructions to prevent or relieve them.

The book is written in almost a conversational manner which in some places leads to verbosity. The reviewer at times felt the desire to condense or eliminate sentences—to get more rapidly to the essential facts.

The first chapter deals with the preoperative examination and care of most neurosurgical conditions. Included is an outline of a very complete neurological examination and the special tests to be made in the diagnosis of certain intracranial tumors. Under separate headings which are carefully indexed are suggestions for the examination and early care of patients with head injury, brain tumor, brain abscess, neuralgia, hydrocephalus, spinal injury, spinal tumor, ruptured intervertebral disc, spina lida and peripheral nerve injury.

Subsequent chapters deal with the operating room preparation of the patient and general operative procedures. Included is a discussion of anesthesia, neurosurgical practices in the control of hemorrhage, the use of suction, cotton, and bone wax. The indications for and technique of vertebrolography are given.

Two chapters are devoted to operative procedures usually with detailed illustrative cases in which such operations were performed. Sachs presents his personal views gleaned from a wealth of material and years of practice as to the best procedure for a wide variety of neurosurgical conditions. Perusal of these by the inexperienced interne or resident, especially just before a listing in the operating room, would greatly enhance his value since he would know in general what was being done and could anticipate some of the needs of his chief. All the usual neurological surgery operations are well illustrated.

An excellent chapter deals with postoperative care a subject so often delegated to comorbid, inexperienced men. Included is the care of the

THE book *The Care of the Neurological Patient* by Ernest Sachs, containing 265 pages with 17

Illustrations. Published by J. B. Lippincott Co., Philadelphia, Pa. Price \$5.00. The book is available in paperback for \$2.50. The book is available in hardcover for \$5.00. The book is available in hardcover for \$5.00. The book is available in hardcover for \$5.00.

bowels and bladder postoperative fever the recognition of a postoperative clot frequency of dressings, and other simple, but from the patient's standpoint, important details.

A careful study of this work by the young resident staff will remove a considerable load from the neurosurgeon and will undoubtedly expedite the recovery of many patients.

MAX M. PERRY

THE breast may well be considered the organ of romance for more reasons than one. It responds to many influences: sexual maturity with its accompanying hereditary or basic variances; the menstrual cycles; pregnancies either going to term or interrupted; lactation brief or prolonged; intercurrent infections; pelvic disease affecting ovarian secretion, early or late in life, the menopause and subsequent senile involutional changes. The anatomical changes in the breast due to the above influences are so varied that, in truth, it is difficult to determine accurately what is within the normal and what is abnormal when one considers evolutionary changes which might present themselves in the largest number of relatively healthy individuals. The breast is an external organ therefore susceptible to fairly accurate evaluation of gross anatomical changes and with slight inconvenience material can be procured for microscopic examination. The examination of the breast is a real art that must be developed in the light of gross and microscopic studies that are properly interpreted. An answer to many of these perplexing problems may be found in the new second edition of *Diseases of the Breast* by Geschickter.

This second edition, follows the first which appeared a few years ago and which was considered by many to mark a milestone in monographic medical literature. New material has been added in this second edition chief of which is the criteria of operability and inoperability of mammary carcinomas; the relative merits of surgery and irradiation in cancer; the endocrine therapy of chronic cystic mastitis; and the etiology of mammary carcinoma. This new edition of approximately 800 pages contains 593 illustrations and many tables.

It is impossible to review adequately this work because of the tremendous amount of material it contains. The basis for opinions and conclusions by the author is placed upon a study of clinical cases seen in the wards of the Johns Hopkins Hospital, a critical analysis of case histories, specimens, and follow-up studies recorded in the Surgical Pathology Laboratory of the Johns Hopkins Hospital and experimental evidence obtained by the author in his own investigative work and that of others. Included is a description of the normal development and functional changes in the mammary gland, the endocrine physiology of the breast and the breast in pregnancy and lactation. The author seems to have

simplified somewhat the subject of chronic cystic mastitis considering it as a mammary dysplasia of varying types. The endocrine aspects of this condition are discussed and, what is important, the possible rôle of mammary dysplasia may play in the occurrence of cancer. It would appear that this latter is the prime factor since by far the largest percentage of breast lesions which are benign do not endanger the life of the patient nor do they markedly handicap the individual. It is the fear of the presence of cancer or the possibility that the lesion is the forerunner of cancer that distresses the patient. In consideration of this association between chronic cystic mastitis and carcinoma, the author states in the preface of this second edition: "The incidence of carcinoma in chronic cystic mastitis (less than three per cent) has been supported by additional statistics and the importance of endocrine factors in the etiology of benign and malignant mammary neoplasms has been extensively confirmed."

Many pertinent facts are presented in the discussion of benign mammary tumors in the light of estrogenic stimulation. In 328 pages devoted to a complete consideration of cancer of the breast reference is made again to the importance of recognizing a thorough radical mastectomy as the treatment of carcinoma of the breast in the so-called operable stage. One point the author brings forth is difficult to comprehend. In advising irradiation after radical mastectomy when axillary nodes are present, he states that there is about 5 to 7 per cent increase in the 5 year survival over that procured with only the radical mastectomy. It would seem logical to conclude that by far the largest percentage of deaths due to carcinoma of the breast are the result of distant metastases such as to the viscera and not to purely local recurrences. The question involved is whether such fatal visceral metastases are the result of local recurrences or whether they were present or took place at the time of the radical mastectomy. If the former then postoperative irradiation might be of benefit but if the metastases were present at the time of operation irradiation will be of no final benefit. Serious consideration must be given to events that may occur when the patient is examined while the diagnosis is made such as excessive manipulation of the breast, thus spreading the disease and possible spread during the operation.

The experimental evidence on production of mammary dysplasias and tumors including carcinoma is extremely interesting. One cannot escape the conviction that the promiscuous administration of hormones especially the estrogen group may have potential dangers. This warning may be timely now when there seems to be a trend to give women estrogenic substances for so many resistant conditions and complaints that do not yield to commonplace therapy.

The author has without doubt accomplished his purpose which is well expressed in the preface to the first edition: "In recent years contributions to the

DISEASES OF THE BREAST. By Charles F. Geschickter, M. A., M. D. With special section on treatment in collaboration with Murray M. Campbell, A. B., M. D., F.A.C.S., 2d ed. Philadelphia, London: Mosby, J. B. Lippincott Co., 1945.

etiology the diagnosis and the treatment of mammary disease have accumulated rapidly. Much of the progress made can be attributed to the different groups of special is interested in these problems. The specialties concerned include surgery, radiology, obstetrics and gynecology, pathology, endocrinology and laboratory technology. In bringing together in this volume the work done in these diverse fields the usefulness of this information to the general practi-

tioner as well as to the specialties enumerated has been the foremost in mind." In this volume there is placed at the disposal of the practitioner an enormous amount of information that he must have if he expects fully to comprehend his responsibilities and escape the pitfalls before him when diagnosing and treating diseases of the breast. The many excellent illustrations add much to the text.

JOHN A. ROEHL.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

A TEXTBOOK OF SURGERY. By American Authors. Edited by Frederick Christopher, B.S. M.D. F.A.C.S. 4th rev. ed. Philadelphia and London W. B. Saunders Co., 1945.

ETIOLOGY OF TROPICAL DISEASES. AN ATLAS. By J. F. Ash, Colonel M. C. U.S. A., and Sophie Spitz, M.D. U.S. A. Philadelphia and London W. B. Saunders Co., 1945.

A MANUAL OF SURGICAL ANATOMY. Prepared under the auspices of the Committee on Surgery of the Division of Medical Sciences of the National Research Council. By Tom Jones and W. C. Shepard. Philadelphia and London W. B. Saunders Co., 1945.

AMPUTATION PROSTHESES. ANATOMIC AND PATHOLOGIC CONSIDERATIONS, WITH PRINCIPLES OF ALIGNMENT AND FITTING DIAGNOSTIC FOR THE SELECTION AND LINEAR PLANT FACTURE. By Alva Thomas, M.D. F.A.C.S. and Chester C. Madden. Philadelphia, London, Montreal J. B. Lippincott Co., 1945.

CLIFF FALLEN AND SPIDER. By Muriel E. Morley. B.Sc. F.C.S.T. Baltimore: A. William Wood Book. The W. B. Saunders Co., 1945.

THE 1945 YEAR BOOK OF RADIOLOGY. DIAGNOSIS, Edited by Charles A. W. C. M.D. and Whitner B. F. M.D. THERAPEUTICS, Edited by Ira I. Kaplan, B.S. M.D. Chicago: The Year Book Publishers, Inc., 1945.

LA TUBERIEUSE ACTUELLE DE LAS HERIDAS. CIRUGIA BELLA MEDICA PRINCIPAL. By Pedro D. Caruchel. Buenos Aires: Editorial L. J. Atecos, 1945.

WAR SURGERY. By Roy R. Grinker, Lt. Col., M.C., and John P. Spiegel, M. Jor. M.C., U.S. A. Philadelphia and Toronto: The H. K. Lewis Co., 1945.

ANATOMY OF THE SURGICAL. By Sheila Maureen Dwyer, R.N. B.S. and George W. Fish, M.D. With a foreword by Helen Young, R.N. Philadelphia: Lea & Febiger, 1945.

STUDIES ON PROTEIN METABOLISM IN THE CELLS OF LIVER TUMORS. By Torbjørn Caspersen and Lars Sævi. Stockholm: Kungl. Boktryckeriet, P. A. Norstedt & Söner, 1945.

EXPERIMENTS WITH MAMMARY CARCINOMA EXTRACTS IN REGARD TO CELL FREE TISSUE REACTION AND TUMOR IMMUNITY. FURTHER STUDIES OF THE KATA-RASE NITRILE, WAGNER SURGICAL. By Carl Kretz, Oskar Thordarson & Johannes Harbo. Aarhus: Aarhus Kommunehospital Røntgen & Lysklinik Og Røntgenstationer For Jylland, 1945.

THE VALUE OF THE BURTON EXTERNA IN THE DIAGNOSIS AND TREATMENT OF INTERSTICITIS IN CHLORIDE. Illustrated by about five hundred Danish Cases. By Jens Munch. Nordstedt. Copenhagen: Elmer Munksgaard, 1945.

URTER KISTOGRAFI IN THE MALL. THE SPECIAL REGARD TO MICTURITION. By Nils P. G. Edling. Stockholm: Kungl. Boktryckeriet, P. A. Norstedt & Söner, 1945.

POSTURAL CIRCULATORY AND RESPIRATORY CHANGES DURING EXERCISE AND INTERMITTENT ANESTHESIA. AN EXPERIMENTAL ANALYSIS OF THE SIGNIFICANCE OF POSTURAL CHANGES DURING ANESTHESIA IN THE MALL. RE AND TO THE VALUE OF THE HEAD-DOWN POSTURE IN REPERCUSSION. By Torsten Gorth. Stockholm: Fritze & Söner, 1945.

CEREBRAL ANGIOGRAPHY WITH PERABOOL (CAROTIS ANGIOGRAPHY). By Arne Engström. Oslo: Jahnke & Söner, Boktryckeriet, 1944.

RE AL TECTICULI AND ROENTGENOLOGIC EXAMINATION. A SURVEY AND A COMPARISON BETWEEN THE EFFICIENCY OF THE DIFFERENT DIAGNOSTIC METHODS IN SIXTY CASES OF SERGIC RE AL TECTICULI, WITH A SPECIAL VIEW TO THE ROENTGENOLOGIC DIAGNOSIS. By Ragnar Stenert. Oslo: Grøndahl Trykk, 1944.

THE MECTICULI AND MICTURITION. THE SPECIAL REGARD TO THE PROBLEM OF THE ROENTGENOLOGIC DIAGNOSIS OF THE STOMACH IN THE LIGHT OF COMPARATIVE ANALYSIS OF MICTURITION. By Johan Torgersen. Oslo: Jahnke & Söner, Boktryckeriet, 1945.

THE RADIO-SENSITIVITY OF THE BOWEL MALL. By Torbjørn Demstad. Oslo: Centralitykkeriet, 1945.

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I proposed prophylactic treatment consists of education of the laity and the profession to lead to early diagnosis and conservative treatment. Cleanliness should be advocated and prevention of undue chronic skin irritation especially prevention of carcinogenic exposure in industry under the supervision of industrial surgeons.

The differential diagnosis includes syphilis (especially tertiary lesions) mycosis fungoides leprosy leishmaniasis, skin tuberculosis, Bloch's sarcoid lupus erythematosus, and lupus verrucosus.

Treatment consisted of a routine in which 90 per cent of the cases were referred to surgery and 10 per cent for radiation alone. Biopsy of large but not obvious carcinomas was practiced small lesions were excised for biopsy. In the author's clinic excision gave prompt and often superior results as compared to radiation especially when the late effects of radiation skin atrophy and telangiectasias are considered. He did not believe that radiation therapy was successful despite some excellent late results in the cases in which bone or cartilage were involved. Painful cases when inoperable or when the patient had an uncontrolled systemic disease or was of an extreme old age with cardiovascular disease, were referred for radiation. Less extensive carcinomas involving only the soft tissue were also referred for radiation.

Surgical high-frequency currents were used for desiccation until all the lesion was removed when the lesion did not exceed 5 mm. Inexperienced use of the high frequency current often resulted in deep and indolent ulcerations. Radium after electro-desiccation is not thought necessary.

Adequate surgical resection wide of the tumor is the treatment of choice. Special problems exist in the case of lesions of the nasolabial fold in which involvement of the nasal cartilages or ethmoid or maxillary sinuses is frequent, and in the case of lesions of the ear in which early metastases to the regional lymph nodes are seen. Results in such lesions are not always favorable except in very small early lesions unless radical procedures are followed. In the more advanced or recurrent lesions extremely wide excision and electrocoagulation is preferable and it is often successful after simple surgery or radiation has failed. Novocaine block and local infiltration is the preferred type of anesthesia no spreading of the tumor by the needle was observed.

When possible, immediate reconstructive procedures were done, even in radical resections. In the cases of bone or cartilage extension monthly biopsies of suspicious areas, followed by further excision if positive, were practiced for from six months to a year before plastic operations were done. Tiersch-Ollier skin grafts and pinch grafts for infected defects, and skin flaps and full thickness grafts for larger defects were used. A complete statistical analysis of the surgical and radiation therapy is given. The results seem to be excellent.

A method of regular follow up to catch early new cases or recurrences for a period of from three to five years, or preferably for a lifetime at yearly intervals after five years is practiced.

JAY P. BARTLETT, M.D.

EYE

GILMAN, R. U.: An Analysis of 100 Cases of Strabismus Treated Orthoptically. *Brit J Ophth.*, 1945 29 450.

This article is a study of binocular function in 100 patients who were treated in 1943 and 1944 at the West Bromwich and District Hospital. The patients were divided into 3 groups.

1. A group of 63 who were treated by orthoptic methods only. The results showed that in 36 patients the condition was corrected and there was good stereoscopic vision.

2. A group of 37 patients who were treated by both orthoptic methods and surgery. In 23 the eyes were described as straight and 17 of these developed good or fair stereoscopic vision.

3. A controlled series of 50 patients under observation for an average of nine months with no treatment other than lenses. This treatment did not result in the development of stereopsis in any case.

An analysis is made of the refractive findings in the 100 patients studied. The question of a possible strabismus is discussed, and the absence or failure of stereoscopic vision is held to be the greatest etiological factor in its development.

HUGHES H. RICHARDS, M.D.

Shenkin, H. A., and Leopold, I. H.: Localizing Value of Temporal Crescent Defects in the Visual Fields. *Arch. Neur. Psychol.*, Chic., 1945 54 67.

The fact that the most peripheral portion of the temporal visual field has an unpaired representation in the optic pathways and visual cortex has been well recognized. This unpaired portion is called the temporal crescent or half moon. The paired portion has a diameter of approximately 120 degrees and the unpaired portion extends for from 30 to 40 degrees on each side beyond the paired portion. Bender and Strauss (*Arch. Ophth.* 1937 19 765) reported 10 cases in which, as a result of defects in the optic radiations an unpaired crescentic or hemicrescentic vision existed in the periphery of the temporal field. They concluded that an unpaired peripheral scotoma indicates an early defect in the optic radiations, and that such a finding has localizing value in the early diagnosis of tumor of the brain.

It is the purpose of this article to substantiate these observations of Bender and Strauss with 5 verified cases of brain tumor and to emphasize the value of this sign as an aid in the practical localization of a pathological cerebral process.

In the first case, perimetric studies showed a distinct crescentic cut in the right field of vision without any changes in the central field. Operation in this patient uncovered a large meningioma in the

left parieto-occipital region. In the second case there was a crescentic cut in the left visual field and operation disclosed a large meningioma of the right parietal region. In the third patient, in whom a temporal crescentic defect in the left visual field suggested injury to the right optic radiation, a bone flap was turned down in the parieto-occipital region but the dura was not opened. Perimetric examination performed four weeks after the first surgical procedure showed an incongruous left homonymous hemianopsia. Subsequently the tumor was exposed and proved to be a well demarcated cystic astrocytoma deep in the right parieto-occipital region. In the fourth case a temporal crescentic defect in the right visual field resulted in uncovering a large cystic glioma of the left parietal area and, finally, in the fifth case a temporal crescentic defect in the left visual field with, as in the previously cited examples, no sign of changes in the central field was apparently induced by a glioblastoma multiforme of the right temporo-parietal area.

The author admits that no exact anatomic information may be derived from these cases as the position of the tumor itself may not tell the entire story that is cerebral tumors produce edema and other distant phenomena which may also cause disturbances in the fields of vision. However he believes that the 5 cases here reported bring out the importance of the temporal crescentic defect as an early localizing sign, and thinks that a 5 degree difference between the two fields should be regarded as significant.

JOHN W. BRENNAN, M.D.

Wright, R. E., and Stuart Harris, C. H.: The Penetration of Penicillin into the Eye. *Brit J Ophth.*, 1945 29 428

This article describes the clinical and biological techniques used in evaluating the penetration of penicillin into the eye. It is noted that the penicillin that reaches the aqueous humor after local use or intramuscular injection is of very low concentration. It is noted that the use of iontophoresis gives a far higher intraocular concentration, but the method of application is a technically difficult procedure. The procedure is described.

HUNTER H. ROMAIRE, M.D.

Davidson, M.: Compensation for Ocular Injuries in the United States. *Am J Ophth.* 1945 28 856

As is well known to those engaged in industrial work, there is a great discrepancy between the laws of the various states regarding compensation for an industrially damaged eye. The Federal Government itself operates with two standards in different departments. The range is so great that five times as much is given in some states as is awarded in others for the loss of an eye. This calls for standardization of benefits for permanent and temporary visual disability for facial disfigurement and for percentage of weekly wages to be paid out.

There are six main items which should be established

1 The amount that should be awarded for the loss of an eye, or loss of its use, in terms of percentage of the award for permanent total disability

2 The definition of loss of use of one eye and loss of use of both eyes (permanent total disability)

3 The definition of normal central visual acuity for distance and the degree of departure from normal that is subject to compensation

4 The method of dealing with partial loss of central visual acuity for distance

5 The method of dealing with the principal colateral or auxiliary functions of vision (muscles fields, accommodation)

6 The maximum deduction for temporary disability if any from the award for permanent damage to an eye

Each of these subjects is discussed in detail with illustrations of the inconsistent treatment in various states and much of the report of the American Medical Association Committee on Visual Economics is analyzed and criticized.

It is recommended that the average annual cost of compensation be taken as a standard and be made uniform for the country. The prevention of accidents is really the big problem and headway is being made in that direction.

WILLIAM A. MANN, M.D.

EAR

McCurdy, G. J.: Endaural Mastoidectomy Five Years Experience. *Laryngoscope* 1945 55 349.

This is a report of 122 cases of endaural mastoidectomy performed over a period of five years. Certain disadvantages are mentioned for the simple mastoidectomy such as persistent bleeding, the formation of unsightly scars and the difficulty in reaching tip cells in certain cases. Trauma to the temporal muscle occurs occasionally.

Among the advantages are continuous drainage during wound healing and the fact that the tympanic cells can be dealt with more easily. Postoperative care is reduced to a minimum and the scar is usually invisible. No packing is necessary in the depth of the wound.

There were no disadvantages in radical and modified radical cases, but there were several distinct advantages among them were better exposure of the entire mastoid areas, no necessity for plastic surgery at the end of the operation and the absence of postoperative packing.

JOHN F. DELANEY, M.D.

NOSE AND SINUSES

Griesman, B. L.: Structure of the External Nose. A Study from the Point of View of Plastic Surgery. *Arch. Otolaryng.* Chic., 1945 42 117

The author states that the final cosmetic result of a rhinoplasty depends not only on the surgical procedures but also on the influence of intrinsic and extrinsic stresses on the process of healing.

The force of mastication is the main physiological stress on the facial skeleton in the vertical and longi-

tudinal planes. The nasofrontal, malar zygomatic, and pterygoid buttresses transmit the chewing stress to the vault of the skull.

The nasal septum has a complex function in that the vomer seems to transmit chewing stress to the body of the sphenoid. The cranial portion of the septal cartilage and the upper lateral cartilages form a resilient arch to keep the nostrils open, and the caudal portion of the septal cartilage supports the nasal tip. In the typical rhinoplasty the lateral osteotomy interrupts in part the lines of force in the anterior or nasofrontal buttress. The act of chewing in the postoperative period tends to cause more callus to be formed along the sawcuts which, in turn may interfere with the desired cosmetic result. Therefore it is recommended that the chewing of hard or tough foods be omitted during the first six weeks following operation and that biting with the incisors be prohibited. JOHN R. LOOMAY, M.D.

MOUTH

Lawrence, E. A. and Bresina, P. S.: Carcinoma of the Oral Cavity. *J. Am. M. Ass.* 1915, 15: 10-1

Lawrence and Bresina report a series of 145 cases of carcinoma of the oral cavity seen at the New Haven Hospital, New Haven, Connecticut January 1, 1911 to December 31, 1910 inclusive.

The largest group of cancers from the point of view of numbers occurred in the hypopharynx and posterior tongue. Anatomically they include all tumors in the pharynx lying between the circumvallate papillae of the tongue and the extrinsic larynx. The tumors of the anterior part of the tongue include all which are anterior to the circumvallate papillae. The tumors on the floor of the mouth include those in the area bounded laterally and anteriorly by the inferior alveolus and medially by the tongue. The tumors of the alveolus include those in both upper and lower gum margins. The tumors of the buccal mucosa include those in the mucous membrane lining of the cheeks and inner lips. The tumors of the palate include those of both the soft and hard palates and the tumors of the tonsil include tumors originating in the tonsillar fossa. There were a few cancers of the oral pharynx that were so extensive and involved such a large area (palate, tonsil, base of the tongue and floor of the mouth, for example) that they were difficult to classify as to their point of origin. Therefore since they would have formed such a small group as to be completely meaningless, they were placed in the major groups according to where the bulk of the tumor lay.

The therapy of oral and pharyngeal carcinoma is a difficult and discouraging problem. There can be only rare individuals who are naive enough to believe that radiation therapy and surgery are ideal therapeutic instruments. Yet, until something better is discovered, these two methods remain our only hope of obtaining survivals in the treatment of this as well as of other cancer. Until that method

appears, attempts at improving our results must be directed not only toward the more intelligent use of these two instruments but also toward making them more available to the general public and practicing physicians at large, and toward educating the public and physicians in the early signs and symptoms of this disease. Perhaps it is incongruous to suggest, in face of the fact pointed out that there was no more delay in the failure group than in the successful one that early diagnosis is important. However it is a simple platitude that a small tumor is more easily and satisfactorily treated than a large one, and if the individuals harboring such tumors could be seen when the tumors are small there is no doubt that greater success would be obtained. Seven of the 16 patients with carcinoma of the hypopharynx stated at the time of admission that their chief complaint was a lump in the neck. In other words, more than 25 per cent of the patients in this group were complaining of something which indicated that for practical purposes the disease was beyond the curable stage. What would have happened if the tumor had been discovered when it was only 1 cm. in diameter?

The educational program must be intensified in the dental profession as well as in the medical profession so far as oral carcinoma is concerned. Thirty seven of the patients in this series had been seen first by a dentist. Ten of the 22 with alveolus tumors had been seen and treated by a dentist before being referred for medical care, and 8 of these had delayed for more than two months. One had been under active care for nearly a year and a half. If our primary objective were to find and treat the disease before the regional lymph nodes become involved, the salvage would be large. A specific example is shown by the tumors on the anterior part of the tongue. Only 2 of the 14 patients with lymph-node involvement survived five years whereas 3 of the 9 without node involvement were living and well at the end of the same period.

As far as therapy itself is concerned probably the cardinal point in successful management is attention to detail. The utmost care must be used in localizing the tumor and involved nodes, if present, in localizing the treatment ports, in directing the treatment beam precisely not only at the initial treatment but also at all other treatments, in management of the radiation reaction and in securing frequent follow-up examinations in the early post therapy months so that if an extension or recurrence appears further treatment can be initiated promptly. The problem of dosage is not complicated. If epidermoid carcinoma is to be destroyed, a dose of at least 5000 roentgens must be delivered into the tumor. This usually requires supplementary interstitial radon in addition to roentgen therapy. Ideally the x ray treatment should be administered in about twenty-one treatment days, and radon should be inserted when the tumor has regressed to its maximum degree. The authors believe that radiation should not be delivered so rapidly or so

extensively that it will produce a pronounced degree of tumor necrosis with infection because it is their impression that infection stimulates tumor growth.

BENJAMIN GOLDMAN, M.D.

NECK

Sandberg, I. R.: Dissection of the Cervical Lymph Node Regions for Metastasis from Malignant Tumors of the Lip, Oral Cavity and Pharynx. *Acta chir scand.*, 1945 92 99.

The lymph node regions to which cancer of the lip, mouth and pharynx first spreads are described and illustrated. The submental and submandibular regions and the superior and inferior deep cervical nodes are apt to be involved. Three operative methods are used for the surgery of these lymph gland metastases. The first consists of radical massive dissection of all the primary lymph nodes involved, the second of dissection of the submandibular region with or without that of the submental region, and the third of extirpation of single lymph nodes or groups of nodes. The latter method is justifiable only for purposes of diagnosis. The technique of operation is described in detail and illustrated.

A discussion is given of 73 cases of lymph gland metastases operated on at the Karolinska Hospital in Stockholm. 93 operations were performed in these cases.

Fifty-six of the patients were men and 17 were women. The youngest patient was 35 years of age, the oldest 80. 75 per cent of the patients were over 50 years of age. 41 per cent over 60 and 18

per cent over 70. A table is given showing the site of the primary tumors and the nature of the operations.

In radical dissection, especially in advanced cases it is almost impossible to avoid injury of the nerves. There is often transitory paresis of the facial nerve and sometimes permanent injury. The accessory nerve is also quite frequently injured which results in partial paralysis of the trapezius muscle. Dissection of the internal jugular vein is sometimes slow and difficult and rupture of the wall of the vessel may cause fatal air embolism.

In this series of 73 cases there was only 1 death (1.4% mortality). The patient was a man of 54 years who died of anoxemia resulting from laryngeal edema. Among the 39 massive radical extirpations performed on 37 patients the mortality was 2.7 per cent. The mortality at the Zurich Clinic from 1927 to 1936 was 14.4 per cent (13 deaths among 113 patients) but the massive radical method was used in most of these cases. The average stay in the hospital for the author's cases was 10.5 days. This was perhaps shorter than usual because most of the patients were removed to the Radiumhemmet for postoperative irradiation. It is hard to determine by histological examination whether a piece of tissue has been irradiated or not for the changes caused by irradiation may also occur spontaneously.

It is difficult to judge the final results in this series of cases as the time since operation has not been long enough. But among 53 patients who were examined a year after operation, 31 were alive and free of signs of recurrence. 8 showed recurrence. 12 had died from cancer and 2 had died from other diseases.

AUDREY G. MORGAN, M.D.

SURGERY OF THE NERVOUS SYSTEM

PERIPHERAL NERVES

Denny Brown, D., and Doherty M. M.: Effects of Transient Stretching of the Peripheral Nerve. *Arch. Nerv. Psychiat. Chic.*, 1945, 54: 116

Dense intraneural fibrosis of the peripheral nerve without anatomic loss of continuity is seen in modern warfare. It is due in some way to the passage in close proximity to the nerve of a projectile traveling at high velocity. The authors previously investigated the pseudoneuroma produced by percussion of a peripheral nerve which does not conform to the lesion under discussion. Because of the great and rapid distortion of soft tissues produced by the impact of a high velocity bullet, the possibility that this caused a sudden longitudinal stretch in the nerve was investigated.

The reproduction of such a rapid longitudinal stretch by experimental methods is difficult, and finally it was decided to produce the stretch by means of grasping the nerve in the gloved fingers. The peroneal nerve of the cat was used and the animal was placed under pentobarbital anesthesia. The nerve was marked at measured intervals and the extent of the stretch was recorded in percentage terms. Survival ranged from 5 to 140 days. A table with the essential points is provided. When the nerve was stretched until the distance between the markers was increased 100 per cent there was often no sign of hemorrhage within it and only slight weakness was noted when the animal recovered from anesthesia. Full motor power returned within four to ten days. If stretching was continued beyond 100 per cent of the distance between the markers a sharp "crack" or "snap" occurred. A small white hernia of nerve fibers was seen next to the main nerve bundle and if tension was persisted in the whole nerve bulged out through the sheath. The resistance of the nerve to further tension was then much reduced. The herniation was always followed by complete paralysis. The smallest hernia was allowed to remain 141 days, recovery commenced about the twenty first day and was complete in 48 days. On section a large pseudoneuroma was found. In the early stage of a small hernia rupture of the epineurial vessels and thrombosis of the small arterioles were found on section.

The difference between benign pseudoneuroma and true neuroma depended on the degree of disorganization of the architecture of the nerve bundle. Unaided recovery is to be expected from the pseudoneuroma but not from the true neuroma. A test for perineurial continuity is therefore of practical importance. The injection of saline solution along the neural fasciculus is the most useful test and the one most commonly employed. The true neuroma is also adherent to the surrounding structures, whereas the pseudoneuroma presents a smooth, unbroken

surface. Unfortunately high velocity bullets often result in scar tissue in the proximity of the nerve which, whether it contains a pseudoneuroma or not, may be adherent to the surrounding structures.
ANASTAS VASSAROVICH, M.D.

Ward, R. L. and Mason, A. B.: Polyneuropathy after Jungle Sores. *Brit. M. J.* 1945, 2: 59

Among the many appalling geographical and climatic hardships in the Burmese jungle were jungle sores which were multiple indolent ulcers developing usually on the lower leg or forearm. In 21 patients who had had jungle sores peripheral polyneuropathy was found. In all but 1 the sores had healed before admission to the hospital on account of the neuropathy. The typical ulcer was about 3/4 inch in diameter and circular or oval in shape and it presented a necrotic, sloughing punched-out appearance.

The clinical course was rather typical. In 16 cases the first symptom of nervous involvement was blurring of the vision which came on about 7 weeks after the jungle sores began. There was disturbance of sensation in all of the cases although in the mild ones this amounted only to paresthesia. There was occasional difficulty in writing and in walking. In severe cases there was progressive weakness of the limbs to the shoulders or hips. In some the gait deteriorated to the point where walking was impossible. According to the severity of the case there was anesthesia and trophic and ataxia. A table with the principal signs and symptoms is provided.

The etiology of the polyneuropathy was of particular interest. Chemical poison could be excluded. When polyneuropathy was due to vitamin B deficiency it responded to vitamin therapy. In contrast to these cases a toxin was suspected and diphtheria bacilli were isolated from the sores. The paralysis of accommodation also gave support to this view. There was no relation between the site of the sores and the limbs in which the polyneuropathy developed. The toxin could not be obtained. Ordinary diphtheritic infection was a very unlikely possibility.

Because of the circumstance no laboratory investigations were possible and the cases are presented from the purely clinical standpoint.

ANASTAS VASSAROVICH, M.D.

BRAIN AND ITS COVERINGS CRANIAL NERVES

Michaelsson E.: Pneumocephalus. *Acta chir. et med.* 1943, 29: 3

In external pneumocephalus the air is situated between the skin and the skull. In internal pneumocephalus it is found inside of the skull. Pneumocephalus generally results from fracture or penetrating injuries of the skull, although it may be caused by chronic inflammation such as tubercu-

low or syphilis. The fractures that most frequently cause it are those of the frontal bone. The most common type of pneumocephalus is the subdural. The symptoms are rather indefinite, being those of cerebral pressure in general. Diagnosis by roentgen examination is now quite simple. There are two dangers to be feared: infection and cerebral pressure. Dandy advocates immediate operation in all cases on account of these dangers.

The author describes a case in a young man of 16 years who fell from his bicycle on July 12, 1941 and incurred a fracture of the right frontal and ethmoid bones. On admission to the hospital there was bleeding from the nose but not from the ears and the only apparent injury was a cut 3 cm. long in the right frontal region which was sutured. He had apparently recovered completely when he was discharged on the 4th of August. No roentgen examination of the skull was made.

About two weeks later he began to have a discharge of fluid from the nose. Roentgen examination showed a fracture of the frontal bone which probably extended into the ethmoid and there was air underneath the dura and throughout the ventricles. He was put at rest in bed and later sulfonamide was given. He had a subfebrile temperature with occasional peaks to 38.6°C and a leucocyte count ranging from 12,000 to 17,000. On September 18 the right frontal lobe was exposed, trepanation was done, and air and liquid were aspirated from a softened portion of the right frontal lobe over which the dura was thin and flabby, although there was no definite defect in it. A graft of fascia lata was placed over the changed part of the dura and the patient made an uneventful recovery.

As there was no real defect in the dura the good results could hardly be credited to the fascia transplant. It is possible that the aspiration of fluid and air brought about the recovery.

AUDREY G. MORGAN, M.D.

Gaynor W. C. and Gurwitz J.: Experiences with 154 Penetrating Wounds of the Head. *Ann. Surg.* 1945 122: 12.

A series of 156 consecutive craniotomies performed in a forward hospital for penetrating wounds of the head are reported. The dura was intact in 19 cases and penetrated in 137. The average time in interval between injury and definitive treatment was twelve hours. The authors agree that these patients can be transported better before operation than after but they believe that the delay (up to seventy-two hours) required to get the injured back to a base hospital would not be tolerated by many. The forward evacuation hospital presents the ideal place for this surgery since it is the most forward site where adequate neurosurgical facilities are available and a roentgenologist is present.

The management of these cases is described in detail. It conforms in most aspects with that recently reported by other workers. Endotracheal ether anesthesia was found to be the one of choice

after extensive experience with local anesthesia and intravenous pentothal.

The authors found a long magnet tip to be very useful in removing metallic foreign bodies. The latter were consistently found to be contaminated when cultured and it is believed that all metallic as well as bony foreign bodies should be removed.

The operative mortality was 10.8 per cent (17 deaths). There were 5 cases in which the ventricle was opened and 2 of the patients died. The frontal sinuses were involved in 26 cases. The sinus walls and mucous membrane were removed which obliterated them. The results were stated to be satisfactory. There was no selection of cases except in times of heavy fighting when there might be several head cases waiting. In such instances priority was given to the patients with the best chance for survival and return of function. Thirty-four other than those included in this series were seen in the receiving tent and 33 of these died promptly.

The wound tract was dusted with sulfanilamide in the early part of the series, and filled with from 7,500 to 20,000 units of penicillin in the later cases. The dura was closed in all cases, a graft being used in most instances. Fascia lata was used in a few cases but temporal fascia, pericranium or galea was used in the majority. Cadaver dura was used in 33 cases with no early untoward results. It is preserved in 10 per cent formalin for forty-eight hours and then in 70 per cent alcohol indefinitely.

Two-thirds of the patients had other wounds as well. Head wounds can generally wait for treatment better than extensive wounds of the abdomen, chest or extremities. The staging of multiple operations is better than doing all of the surgery at once. Nine cases operated upon in stages resulted in 2 deaths, while 5 cases operated upon in one stage resulted in 3 deaths. HENRY A. SMITH, M.D.

Redlich F. C. and Dorsey J. F.: Dental of Blindness by Patients with Cerebral Disease. *Arch. Neurol. Psychiat.* 1945 53: 407.

Detailed reports are given of 6 patients who were blind but who denied their blindness. The patients all had diffuse cerebral lesions and showed mental deterioration with disorientation, impairment of recent memory, and amnesic aphasia. The underlying organic disease was diabetic retinopathy in 1 case, optic atrophy in 1 case, and bilateral hemianopsia due to tumor or vascular lesions in 4 cases.

The authors also review the literature. In their opinion mental deterioration alone does not explain the syndrome; they believe that the interruptions of reverberating circuits between the thalamus and the sensory cortex constitute the outstanding etiological factor. ADRIEN VERBAUGHEM, M.D.

Dandy W. E.: Diagnosis and Treatment of Strictures of the Aqueduct of Sylvius (Causing Hydrocephalus). *Arch. Surg.* 1945 51: 1.

The symptoms of hydrocephalus may appear in infants or in older children. In infancy 95 per cent

If the cases are due to congenital stricture of the aqueduct of Sylvius and in childhood 95 per cent are due to tumors. In infants cases are seen also in which hydrocephalus occurs as the result of occlusion of the foramina of Magendie and Luschka. In both aqueduct and foramen obstruction, the dye test with phenolsulfonphthalein will show it. There is, however, one differential point in obstruction of the aqueduct the inion is low whereas in obstruction of the foramina of Magendie and Luschka the inion is high. This is due to the location of the obstruction—in one the tentorium is pushed upward and in the other downward. In children and adults without localizing cerebellar signs, ventriculography may have to be done to localize the site of the obstruction. In most cases in which complete filling of the ventricular system has been accomplished, an accurate localization of the point of obstruction is possible. The height of the inion has been used for diagnosis in 5 cases without ventriculography and operation, in which there was a stricture of the aqueduct.

Ventriculostomy has been the operation of choice in dealing with these cases. Cerebrospinal fluid is short-circuited from the third ventricle into the cisterns at the optic chiasm and cerebral peduncles. It appears to be essential to open the floor and not the roof of the third ventricle. Two types of ventriculostomy, through the floor have been employed. The author in 1932 proposed an anterior approach through a small supraorbital incision. This was not always satisfactory because an optic nerve had to be sacrificed to gain exposure to the floor of the ventricle, and because the fluid was often improperly absorbed. The procedures advocated by White Stookey and Scarf and by Torkildsen are not considered satisfactory.

It is now proposed that a lateral approach is more likely to satisfy all the conditions. With the child's head in a plaster cast, the right temporal region is opened through a curved incision. Through a small bony opening the lateral ventricle is tapped and the temporal lobe elevated from the middle fossa. The edge of the tentorium and the oculomotor nerve are brought into view. The bulging thin floor of the third ventricle is seen and is opened with a nerve knife, the opening is then enlarged with alligator forceps.

Twenty nine patients over 1 year of age were treated by this method, 5 in the first 5 years of life, 5 in the second 5 years, 15 between the tenth and twentieth years and 4 after the twentieth year. The oldest patient was 45. Thirty-six ventriculostomies were performed on these 29 patients (in some the opening had subsequently closed). There was 1 operative death, while 24 patients are living and cured.

Sixty-three patients under 1 year of age were operated on by this method, 10 of whom died in the hospital and 53 survived. Only 5 are perfectly healthy children, some have died since they left the hospital and others have mental or visual defects.

When the head is not more than from 30 to 52 cm. in diameter the operation is probably worth while.

ADRIAN V. FERENCZ, M.D.

Ingraham, F. D., Bailey, O. T., and Cobb, C. A., Jr.: Fibrin Film. *J. Am. Med. Ass.* 1945 28 1033.

Neurosurgeons have long sought a suitable material with which to cover the brain and to replace dura mater, but so far none has been really satisfactory. The substance, fibrin film, may be the answer to the problem. Its discovery and use were incidental to a protracted program of research undertaken at Harvard Medical School on the "Studies of Plasma Proteins" and this paper is No. 37 in the series. Large quantities of fibrinogen and thrombin became available during the program and from these proteins it has been possible to prepare fibrin film.

A great many films can be produced but this one was selected for the following reasons:

- 1 When this film is placed over the brain of man, it is gradually replaced by a neomembrane of fibrous tissue without the formation of meningeal-cerebral adhesions.

- 2 It is possible to sterilize fibrin film in the final glass ampoule by steam under pressure.

- 3 As judged by animal experiments the film is largely removed in 3 months and completely removed in 6.

- 4 All patients remained free of symptoms referable to fibrin film.

The film has been used in a total of 94 neurosurgical cases presenting a wide variety of lesions.

From the technical standpoint the film is easy to use. It is packed in a glass ampoule from which it is removed under sterile conditions in a dry and brittle state. After it is soaked in saline solution for 15 minutes the paper wrapper is removed and the film placed in cool saline solution until it is required. In this state it is soft, pliable, elastic, transparent, and easy to handle provided it is kept moist. It is rarely necessary to secure the film in place over the brain, although this may be done if desired.

ADRIAN V. FERENCZ, M.D.

Shaloun, E. S.: Purulent Meningitis: Use of Hypertonic Solutions in Treatment. *Lancet* Lond 1945, 249:36.

Purulent meningitis may lead to adhesive obstruction at the foramen magnum and hypertonic parenteral fluids may relieve it, this is the main argument of this closely reasoned paper. The ideas are developed from 11 cases of purulent meningitis seen in the last five months. In 8 cases, and probably in the ninth case the pneumococcus was isolated and in another case the streptococcus pyogenes was found. The remaining case also revealed purulent spinal fluid but no organism was identified even though the staphylococcus aureus was isolated from the wound and from the blood.

The theory of obstruction at the foramen magnum was deduced from two facts: first, early in the meningitis, spinal fluid pressures in the manometer

were of the order of 300 mm. r. ver. her as in later punctures a pressure of 300 mm. was rarely obtained. Second during the individual puncture rather late in the disease there was a progressive slowing in the rate of fluid in the manometer. Clinical and mechanical grounds that were taken to be due to the descent of the cerebellum and the folds into the foramen magnum. A close similarity to these findings exists when spinal punctures are done on brain tumors with increased intracranial pressure. There is a detailed description of the clinical cases on which these assumptions are based.

The clinical significance is twofold: (1) the obstruction at the foramen magnum may give rise to a picture of increased intracranial pressure with stupor, Cheyne-Stokes respiration and slowing of the pulse to 60 per min. and (2) the obstruction also prevents the entrance of therapeutic agents such as penicillin and their reaching the cranial cavity after they have been inserted into the lumbar subarachnoid space.

Experiments were carried out on 2 cases with a view to relieving the obstruction and facilitating the entrance of penicillin from the spinal into the cranial subarachnoid space. The intracranial use of 20 per cent dextrose in physiological sodium chloride was used to decrease the intracranial pressure and to relieve the foramen obstruction and in this way allow free access of the penicillin from below.

Treatment consisted of full doses of sulfadiazine in this case sulfamezathine by mouth. This was considered an essential part of the treatment. Penicillin and hypertonic solutions were given intracranially in calculated doses. The penicillin and the hypertonic solutions were mixed together and injected every three hours. Adults receiving 15,000 units and children a suitably reduced dosage. All cases received 4,000 units of penicillin intrathecally every twenty-four hours. Larger doses do not seem warranted because in 11 cases with initial attack and 15 with relapses, sterile cultures of spinal fluid and corresponding clinical improvement were uniformly obtained in twenty-four hours.

Three deaths occurred—all in pneumococcal cases—and in only 1 did the examination show evidence of active meningitis. In this case pus was found over both cerebral hemispheres with only two foci of pus below the tentorium. One death was due to bilateral basal bronchopneumonia which was considered to have preceded the meningitis. The third death occurred during a convulsive seizure but very little evidence of meningitis was found at autopsy.

ARTHUR VERBEEK, M.D.

SYMPATHETIC NERVES

Koster E. F.: Adrenosympathetic Syndrome Associated with Paraganglioma of the Organ of Zuckerkandl. *Ohio M. J.*, 1945 41: 739

The patient was a thirty-four-year-old female with a three-year history of recurrent episodes of head

ache, nausea and vomiting, insomnia, irritability, flushing and sweating with moderate prostration. During an attack examination revealed a blood pressure of 210/110 and a pulse rate of 120. Precipitous activity was increased but the heart sounds were normal and there were no signs of cardiac enlargement or decompensation. The specific gravity of the urine was 1.023 and the qualitative level of the albumin in the urine was 4+.

The neck was rigid and lumbar puncture revealed a slightly spinal fluid under slightly increased pressure. There was a positive Babinski reflex on the right and the right pupil was larger than the left. Bilateral papilledema was present.

The patient rapidly developed a right hemiparesis passed into coma and died within thirty-six hours of admission to the hospital.

Autopsy revealed an extensive intraventricular and subarachnoid hemorrhage. Cross sections of the brain and examination of the meningeal vessels failed to reveal the origin of the hemorrhage. A small encapsulated tumor (4 by 3 by 2 cm.) was found attached to the anterior surface of the noma immediately caudal to the renal arteries. Microscopic diagnosis revealed benign paraganglioma of the organ of Zuckerkandl.

The symptoms of this patient were believed to be produced by the periodic discharge of adrenaline or a catecholamine substance into the general circulation. Autopsy revealed an associated moderate degree of renal arterial sclerosis. There is a possibility that the hypertension was associated with the renal lesion rather than with the tumor.

HENRY A. SLENNER, M.D.

Kirtley J. A. Jr.: Experiences with Sympathectomy in Peripheral Lesions. *Ann. Surg.*, 1945 122: 39.

The war has demonstrated a variety of indications for sympathectomy in peripheral lesions. This is borne out by a report from a general hospital in a Theater of Operations in the period from March to September 1944. The operations were performed for the following conditions: tender feet, arterial injuries, post-traumatic vasospastic conditions, obliterative vascular disease and causalgia. All were lesions of the lower extremities.

Twenty-three operations were performed on 27 patients with trench feet. The interval between exposure and operation varied between two and seven months. Repeated lumbar sympathectomy had been tried but was found to be successful only in late cases with pronounced vasospasm. Removal of the second and third lumbar sympathetic ganglia made it possible to return 50 per cent of the patients to duty within a month. The best results were obtained in the patients with severe hyperhidrosis, maceration and secondary infection.

In the 20 cases with injuries of the main arteries in the leg especially the popliteal artery, the sympathectomy was limb-saving in some and frequently permitted amputation at a lower level. Patients

SURGERY OF THE THORAX

CHEST WALL AND BREAST

Brantigan, O. C., Aycock, T. B., Hoffman, R., and Welch, H. J.: Relaxing Thoracoplasty. *J Thorac Surg* 9:15, 14, 237

In pulmonary tuberculosis three general types of lungs with corresponding bronchi can be recognized. In one type of lung, the bronchial condition leads to increased intrapulmonary pressure or increased pressure within the tuberculous lesion. It is one in which, either because of organic factors or muscular spasm involving the bronchial musculature, air freely enters into the alveoli during inspiration but its escape is delayed on expiration. In the second type (as opposed to increased intrapulmonary pressure) a form of bronchial condition occurs which leads to a hypotensive lung. In this type the bronchus may be partially or completely occluded by organic disease or its secretions, or by a decrease in the tone of the bronchial musculature, thus permitting only a minimal amount of air into the alveoli, but allowing this air to escape easily. In the third type of lung, the bronchi may be free of organic or spasmodic involvement. Air is permitted to flow freely in and out of the alveoli and bronchial tree. This produces a lung with normal intrapulmonary pressures.

It appeared evident to the authors that if the thoracic cage could be relaxed when the contracting phase of bronchial disease occurred, perhaps the lung could contract easily because the restraining force of a rigid thoracic cage had been removed. The same would be true if healing was taking place by scar tissue contraction. This contraction would be encouraged and it would be more likely to remain until the healing was complete. The belief that a relaxed thoracic cage might be more desirable than a rigid collapsed thoracic cage is strengthened by the evidence that collapse of the lung in itself does not necessarily mean healing nor cavity closure.

With these principles in mind, an operative procedure, which is a modification of Monaldi's operation, was undertaken primarily for patients with tension cavities and for those with extensive disease from the apex to the base on one side but without giant cavities. By interrupting the muscles of the superior aperture paralyzing the diaphragm, and doing costectomies along the dominant line the chest is made static and the lung is freed from respiratory trauma. The operation is divided into 5 stages. If this series of operations fails to bring about an arrest of the disease, the operation can be converted into a standard thoracoplasty. Patients who are not suitable candidates for the standard thoracoplasty might thus be brought safely to such a condition.

The operative procedure was carried out on 33 patients. Their ages varied from 19 to 55 years with the greatest number occurring between the ages

of 30 and 40 years. The longest period of observation was approximately two years and the shortest ten months. In 3 patients the relaxing thoracoplasty was converted into a standard thoracoplasty and, of these, 1 died. Five deaths occurred in the series.

It appears that the patient with a giant cavity is not a suitable candidate for this operative procedure unless one is content with bringing the lesion and the patient to a condition in which the relaxing thoracoplasty can be converted into a standard thoracoplasty. Whether this operative procedure will adequately arrest the disease in the tension type of lung has not been conclusively refuted or affirmed. The patient with a concomitant disease or the one with some collapse of the contralateral lung is a good candidate for this operation. It also appears likely that the patient afflicted with the disease from the apex to the base on one side, but without giant cavities is an ideal candidate for this operative procedure rather than for a complete standard type of thoracoplasty. The individual who has a pulmonary lesion which can be controlled by a one-stage standard thoracoplasty certainly should not be subjected to this type of operative procedure.

On the whole, results are encouraging and certainly worthy of further study. Many patients who formerly had no hope of the disease being arrested are now brought within the realm of surgical treatment. Only time will determine the worth of this operative procedure as well as its indications.

JOSEPH E. NAKAT, M.D.

Engelstad, R. B.: On the Treatment of Carcinoma Mammæ. *Acta chir scand* 94: 87, 545.

It is hard to compare statistics for cancer from different hospitals because of the differences in classification and methods of treatment. The author presents the statistics of 553 cases from the Norwegian Radium Hospital, pointing out that the results are unfavorably influenced by the fact that so large a proportion of the cases were in the late stages, because of the nature of this hospital. Notwithstanding this fact, the patients had 3 years of freedom from recurrence in 94.4 per cent of the cases and 5 years of freedom from recurrence in 92.5 per cent of the cases in stage I. The 3 year and 5 year figures for freedom from recurrence in stage II were 59.1 and 52.2 per cent, respectively. The differences in treatment methods are shown in this group by the fact that the 3 year and 5 year survivals after post-operative radium treatment were 65.4 and 64.5 per cent, respectively while after other methods of treatment they were 49.2 and 48.5 per cent, respectively. The figures for 3 and 5 year freedom from symptoms in stage III were 10 and 8 per cent, respectively and in stage IV 8.4 and 8.2 per cent, respectively.

The conclusion is reached that irradiation treatment cannot replace surgery but that it is a valuable supplement to it. It is believed that the best results can be obtained by giving irradiation treatment postoperatively in one series in as large doses as can be given without injuring the normal tissues and without producing too great leucopenia in the blood. Radium has been found superior to roentgen rays for postoperative treatment.

Local recurrences were for the most part treated by the application of radium. Lymph node metastases, with telradium or roentgen irradiation and skeletal metastases with roentgen irradiation in doses of from 7,000 to 4,000 roentgens. Visceral metastases were given palliative roentgen irradiation in a few cases. There was hilar involvement in 7 per cent of the cases, 24.5 per cent of these were free from recurrence after three years.

The greatest number of cases of cancer of the breast are seen in the age groups from 40 to 49 and from 50 to 59, that is around and immediately after the menopause. This shows the importance of hormonal conditions in the development of these tumors. Further study should be devoted to hormonal influences and to the histological types of these cancers. The prognosis is unusually bad when cancer of the breast coincides with pregnancy or lactation and it is worse in the younger age groups than in the older ones.

AUDREY G. MORRAN, M.D.

TRACHEA, LUNGS, AND PLEURA

Koffman H. J. F. and Crellin J. A.: Penicillin in Suppurative Diseases of the Lungs Due to Streptococcus Hemolyticus. *Ann Int M.*, 1945 33 135

Two patients with lung abscess which developed in the course of sulfonamide resistant streptococcus hemolyticus pneumonia were successfully treated by the authors with parenteral penicillin. The number of days of penicillin therapy 14 and 24, and the total dosage of 1,475,000 and 3,020,000 units are indicative of absorption of penicillin through thin walled cavities when administered over a sufficient period of time. The sputum in the 2 patients became negative for hemolytic streptococcus in three days and two days respectively. Complete healing demonstrated by roentgenogram occurred in twenty-six and thirty-four days respectively.

Intrapleural injection of penicillin supported by intravenous and intramuscular use of the drug obviated thoracotomy in 4 patients with streptococcus hemolyticus empyema, 2 being classified as sulfonamide resistant and the other 2 being considered moribund.

There was no evidence of reinfection or recurrence and aspirated pleural fluid remained sterile after from 24 to 36 hours, when the intrapleural treatment was supplemented by intravenous and later intramuscular penicillin. One patient receiving only intrapleural penicillin retained an infected pleural space until the sixth day after treatment was started

which would indicate that success or failure may hinge upon the supplemental parenteral administration of penicillin.

Residual fibrosis and subjective slight dyspnea necessitated the return to a limited duty status in 1 patient a seaman who had had repeated infections with periodic asthma since the age of four. The 3 others returned to a full duty status in 125, 146 and 151 days respectively.

STEPHEN A. ZIEMAN, M.D.

Rudensky H. Sprong, D. H. Jr. and Woods, C. C.: The Treatment of Empyema. *J Am M Ass* 1945 128 573

The addition of sulfonamides and penicillin to our therapeutic armamentarium has considerably improved the results of the treatment of empyema. Five cases are reported in this study 3 of which were putrid empyemas following ruptured lung abscesses. The patients were treated with sulfadiazine and penicillin administered intramuscularly and intrapleurally following thoracentesis. This combination has proved beneficial in mixed infections both aerobic and anaerobic. No untoward effects were noted from repeated thoracentesis. One case of postpneumonic empyema was treated with penicillin intramuscularly and intrapleurally and another case caused by staphylococcus (albus and aureus) was treated only by the intrapleural administration of from 25,000 to 50,000 units of penicillin in 100 to 200 c.c. of sterile saline solution. The instillation of penicillin was preceded by thorough aspiration of the pus.

One patient who suffered from a pyopneumothorax secondary to osteomyelitis of the sixth and seventh ribs yielded, on aspiration, 150 c.c. of thick, greenish foul pus which on culture revealed the proteus vulgaris and the staphylococcus aureus. Treatment consisted of sulfadiazine given orally and repeated irrigations of the pleural cavity with a 1:3,500 dilution of fresh aqueous azochloramid. The patient's temperature became normal after 9 days and he made a rapid recovery within the next few weeks.

ARTHUR J. LEXER, M.D.

Healy M. J., Jr. and Katz, H. L.: Penicillin for Empyema. *J Am M Ass*, 1945 128 568.

Five patients with empyema were treated with aspirations and intrapleural instillations of penicillin. The average dosage of penicillin ranged from 35,000 to 50,000 units in 100 c.c. of sterile saline solution which was instilled into the pleural cavity after thorough aspiration of the pus and occasional irrigation with sterile saline solution. The procedure was usually repeated on alternate days and the duration of treatment depended on the clinical response. Patients who were believed to have unresolved pneumonia or other complications received also an average of from 20,000 to 25,000 units of penicillin by the intramuscular route. Culture of the pus revealed the nonhemolytic staphylococcus aureus in 3 cases, the pneumococcus (type 3) in 1 case, the pneumo-

lytic streptococcus in 1 case and mixed infection of the nonhemolytic streptococcus and the hemolytic staphylococcus aureus in 1 case.

It is stressed that the treatment should be instituted at the earliest possible moment and that therapy need not await the results of bacteriological culture since the organisms commonly causing empyema are susceptible to penicillin. Thoracentesis should be performed at the lowest point of the cavity with a large gauge needle (15 or 17) preferably under fluoroscopic control and should be repeated until no pus reforms but a small amount of thin, sterile serous fluid is absorbed by the patient in a short time.

The acute episode of empyema was well controlled in all 5 cases. One patient suffering from an extensive empyema, had an acute flare-up after arrest of the disease for four months, which again was promptly controlled by penicillin. However, in this case extensive pleural thickening made further surgery advisable, in order to obliterate the chronic cavity. Three cases showed only a minimal amount of pleural thickening as evidenced by roentgenograms, while 1 case showed no thickening at all. The vital capacity in all 4 cases was undiminished and all 4 patients returned to active military duty within a few months. *Arthur J. Lassar, M.D.*

HEART AND PERICARDIUM

Roscoe C. D.: Heart Injuries; a Report of 3 Cases. Texas J. M. 945, 41, 5

Injuries of the heart are usually penetrating knife and bullet wounds of the chest and heart. The scarcity of cases of nonpenetrating heart trauma in the literature leads one to believe that it occurs rarely. This article was published to arouse interest in traumatic cardiac lesions and to stress the importance of considering possible injury to the heart in all cases of penetrating chest wounds, or direct or indirect trauma to the heart and great vessels in the absence of visible external damage to the chest wall. If we are looking for cardiac injuries we may find those that occur and discover that they are not as rare as suspected. Fortunately most chest contusions produce few functional disturbances, and those produced are usually not recognized.

We usually consider the thoracic cage a perfect armor for the heart and believe the heart to be immune to the usual injuries to which the rest of the body is subjected. The heart, however, lies behind the sternum, buttressed against the thoracic vertebra, and is vulnerable to compression forces applied to the chest. Brady and Kahn have emphasized that no prognosis of a traumatic heart case should be given without considering the following: (1) the physical and psychic condition of the patient prior to his injury, (2) the type, site and severity of the injury, (3) the immediate effects of injury both objective and subjective, (4) the bridging symptoms, (5) the time interval between the injury and the appearance of the disease, and (6) the diagnosis

of the disease, its mode of onset, the site of injury and its course. With penetrating wounds of the chest one should suspect heart tamponade, the signs and symptoms of which are: (1) the patient is usually free from symptoms for several minutes after the wound has been received (able to walk several blocks & fight on), (2) external bleeding stops as the tamponade forms, (3) marked circulatory collapse, which is out of proportion to the blood lost, (4) distant heart sounds muffled and weak (slushing may be heard), (5) weak or absent pulse, (6) low arterial blood pressure, (7) raised venous pressure (from 200 to 300 mm. Hg) with prominent distended neck veins, (8) fluoroscopic examination shows diminution or absence of cardiac pulsations (quiet heart) and (9) marked dyspnea, pallor, cyanosis, or unconsciousness. As heart tamponade is the most common cause of death in heart injuries, the clinician should be able to make the diagnosis and administer conservative emergency treatment. The treatment of penetrating heart wounds as directed by the United States Army is: (1) to aspirate blood from the pericardium, (2) to repeat this if there is recurrence, and (3) to operate if another recurrence takes place.

If lateral chest pressure is applied, ribs are fractured but the heart is rarely damaged. Posterior chest pressure rarely causes any heart damage but anterior force will do so. The force received by the patient depends on the size and weight of the object and its momentum. Anterior and posterior application of force & compression of the heart may cause injury to any chamber of the heart. Bright and Beck believe that all chambers of the heart may be injured by direct trauma. Bilderbeck believes that one possible cause of heart rupture is a sudden compression of the right auricle which becomes engorged because the patient holds his breath in deep inspiration just before a blow is received. White and Glendy believe the heart-chamber distention at the end of diastole or early systole is important in heart rupture. Lewis states that with deep inspiration and a closed glottis the heart dilates markedly and remains in this state as long as inspiration is maintained. The right auricle is most susceptible because of its anatomical relation to the anterior chest wall. This was confirmed by Gouley in whose series 38 cases showed an injured right auricle. The left ventricle is placed deeper in the chest, is better protected, and is a more robust, stronger muscle than the auricle; therefore, it escapes injury. It was damaged in only 1 case. The left auricle was injured in 16 cases and the right ventricle in only 4.

Children and young adults are more likely to have heart damage without external evidence on the chest. Pathologists say the chest wall really is injured in these cases if care is taken to look at the inner aspect where hemorrhage may be found in the interspaces. Persons in middle life do not have heart injuries without damage to the chest wall. Coronary thrombosis due to trauma to the chest is

never found in children and young adults. Coronary thrombosis is found in older people as is a disease of middle life and of older people with atherosclerosis.

In injuries of the lower one half of the sternum and the adjacent sixth, seventh, eighth and ninth ribs on the right side we may expect to find hematomas of the right auricle and injury of the inferior vena cava, diaphragm and liver with immediate death. If the upper half of the sternum with or without the adjacent ribs is damaged there should be annular damage.

Suspicion of heart injury with fluoroscopic examination electrocardiographic studies and careful follow-up should lead to the diagnosis of more cardiac injuries. Beck mentions that the development of the tic tac rhythm is suggestive in suspected cases.

The author presents 3 case reports of cardiac injury. The first was a ruptured aorta originating at a tiny atheromatous plaque at the right posterior aortic sinus in a twenty-six year-old male who was straining to lift a very heavy weight. It was believed that the original tear extended through about half the thickness of the media as this patient did not die until five days after the initial injury when he suddenly developed cardiac tamponade from a hemorrhage into the pericardial sac.

The second case was that of a twenty-seven year old negroess who was stabbed in the chest above the heart from her initial injury only to develop a large aneurysm of the heart presumably from damage to the anterior descending branch of the left coronary artery. She died because of the heart condition nine months after her initial injury.

The third case was that of a forty-four year-old white female who developed myocardial insufficiency and died four years after undergoing extensive x ray therapy over the heart for a breast tumor on the left side. The pathological examination revealed an x ray myocarditis with atrophy of the heart and chest wall.

ROBERT R. BIGGLOW M D

ESOPHAGUS AND MEDIASTINUM

Wason, P P: Incidence of Esophageal Disease in Negroes. *South M J* 1945 38 453

Comparison of the relative frequency of the occurrence of diseases in various races has always been an interesting study. At times variation in the incidence of diseases has been attributed to racial characteristics when environmental and economic conditions may have been the determining factors. In other instances apparent dissimilarity in the occurrence of certain diseases may have resulted from difference in the density of population of various races.

The study of the comparative incidence of esophageal disease in white and in negro patients was prompted by a letter of inquiry from a colleague in an Army hospital concerning a negro whom he had

TABLE I RACIAL COMPARISON OF THE INCIDENCE OF ESOPHAGEAL DISEASE AT THE MEDICAL COLLEGE OF VIRGINIA HOSPITAL 1936-1944

Name of Disease	Number of White	Patients Negro
Carcinoma	67	24
Cardiospasm	38	16
Diverticulum	13	0
Dysphagia functional or hysterical	0	1
Esophagitis	4	0
Foreign body	102	40
Hernia	63	4
Mucellaneous lesions	4	0
Polyps	7	0
Structures (congenital)	29	33
Varices	10	3
Negative esophagoscopic examinations	4	0
	30	11
Total	393	130
Grand Total		523

found to be suffering from cardiospasm. Previous experience and review of the available literature had suggested that cardiospasm was rarely encountered in the negro race.

It seems therefore that lesions of the esophagus which may have their origin in congenital abnormalities are encountered more frequently in the white than in the negro patient, whereas other lesions except cicatricial stricture of the esophagus which usually results from swallowing a solution of lye occur with equal frequency in the negro and in the white person in accordance with the density of population.

Recent studies have suggested that congenital deformities which occur more frequently in white than in negro people may be related to the Rh factor as this factor is universally present in the latter race. This factor may be the reason for the interesting difference in the occurrence of certain esophageal lesions in the negro and in white persons which is difficult to explain otherwise.

BENJAMIN GOLDMAN M D

Smithers, D W: Short Esophagus (Thoracic Stomach) and Its Association with Peptic Ulceration and Cancer. *Brit J Radiol* 1945 18: 199.

The increase in the number of cases reported as congenitally short esophagus has followed the recognition of the association between this condition and peptic ulceration of the esophagus. Two main and conflicting theories have been put forward to account for the frequent association of partial thoracic stomach with peptic ulceration of the lower end of the esophagus. One theory suggests that a congenitally short esophagus is comparatively common and by causing relaxation of the cardia and a reflex flow of gastric juice leads to peptic ulceration. The other

suggests that peptic ulceration of the esophagus is the primary condition and that scarring and contraction resulting from healing pulls part of the stomach into the thorax. One theory puts a congenital defect first and the ulcer second while the other theory puts the ulcer first and an acquired defect second.

The following theory is offered by the author in an attempt to account for the relationship between partial thoracic stomach with the roentgenological appearance of shortening of the esophagus and peptic ulceration of the esophagus.

1. Congenitally short esophagus is rare being seldom found at autopsy. Many cases so diagnosed during life have an acquired or an apparent shortening rarely demonstrable after death. It results from hiatus insufficiency, sometimes developmental, but more often acquired in later life.

2. When the cardiac sphincter in the thorax is released from diaphragmatic control, gastric juice tends to flow into the esophagus and predisposes to peptic ulceration.

3. Irritation of the esophageal mucosa by gastric juice (or probably by esophagitis from any cause) may produce irregular spasmodic contraction of the

lower end of the esophagus which frequently occurs from side to side, but is a longitudinal contraction or shortening. In cases with an esophagus of normal length the relaxation of the contraction and equalization of the pressure in the thorax and abdomen returns the herniated portion of the stomach to the abdomen by the time that a postmortem examination is performed.

4. Heterotopic gastric mucosa may secrete gastric juice into the esophagus or the gastric contents may reach it in other ways (for example, as the result of vomiting, rumination, or relaxation of the cardia following operations) in patients without a lax hiatus. Peptic ulceration of the esophagus may occur in these patients without roentgenological evidence of shortening of the esophagus.

This theory (first, hiatus insufficiency congenital or acquired, and second spasmodic shortening of the esophagus and ulcer) accounts for the known facts and overcomes the chief difficulties associated with the congenital short esophagus and "fibrosis and contraction" theories.

Two cases of short esophagus and cancer are added by the author to those previously published.

JOSEPH E. NARAT, M.D.

SURGERY OF THE ABDOMEN

ABDOMINAL WALL AND PERITONEUM

Coles, J. S.: Operative Cure of Inguinal Hernia in Infancy and Childhood. *Am J Surg* 1945 69: 166.

In considering inguinal hernias in the young one deals principally with indirect hernias since direct hernias are rare and constitute less than 1 per cent of this group. In order to consider adequate surgical treatment one must be acquainted with the embryological development of a preformed indirect sac. The processus vaginalis, an evagination of peritoneum appears at the site of the future internal ring at the third month of fetal life and soon emerges through the anterior abdominal wall. From the fourth to seventh month, it enlarges while the testis lies in the iliac fossa near the anterior abdominal wall close to the pelvic brim. From the seventh to the ninth month, the testis descends through the inguinal canal into the scrotum behind the advancing processus. The testis after entering the scrotum becomes incompletely enfolded by the processus but the tunica vaginalis, that portion of the processus lying in contact with the testis, has a cavity directly continuous with the peritoneal cavity. It is believed that this sac remains patent in from 30 to 50 per cent of the infants at birth. Normally this processus becomes obliterated from the internal ring to a short distance above the testis. The obliteration is aided by the pressure of the abdominal wall and there is solidification of the processus to form the funicular ligament.

There are several possibilities if obliteration does not occur completely. (1) If the processus and tunica remain open the abdominal contents may enter and form a hernia to the lower pole of the testis the so-called congenital hernia. (2) If the processus closes from just above the testis to a short distance below the internal ring the abdominal contents may enter and form an acquired hernia.

and (3) if the processus narrows but does not obliterate at one or more points from just above the testis to a short distance below the internal ring a hydrocele of the tunica vaginalis or the cord with or without an apparent hernia may develop the so-called congenital hydrocele.

If the abdominal contents fail to enter the open processus in any of these types the processus will gradually be obliterated in many cases. The inguinal canal is so constructed that if there is no patent processus vaginalis it is impossible to produce an indirect hernia regardless of the force exerted. In infants the internal inguinal ring is posterior to the external, the thickness of the abdominal wall being the length of the canal. With growth the internal ring is curved upward and outward which makes the canal longer and more oblique. This results in an increasing resistance over the inguinal canal with straining.

That the indirect inguinal hernia is of congenital origin is emphasized by (1) the fact that the vas and blood vessels of the cord have a uniform relationship to the sac, and (2) the fact that indirect inguinal hernia is more frequent on the right side. The later descent of the right testis is apparently related to this factor. The later descent of the right testis is compensated by its final higher position which equalizes the time of obliteration on the two sides. However if the difference in the processus of the two sides were enhanced a greater frequency of right indirect hernias would be expected.

Since 1938 the author believing inguinal hernias are due only to the presence of a preformed sac, has relinquished the common hernial repairs and relies only on a procedure isolating and ligating the neck of the sac. He believes that he observes testicular atrophy by not transplanting the cord with the danger of compression of the cord vessels by not relocating the testis from its bed which causes postoperative swelling of the testis and by not du-

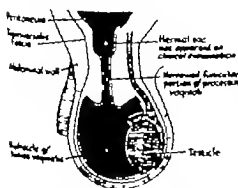
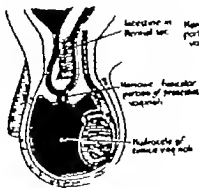


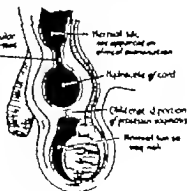
Fig. 1

Fig. 2. Hydrocele of the tunica vaginalis without an apparent hernia.

Fig. 2. Hydrocolic of the tunica vaginalis with an ep-



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178. 2

parent betula.

Fig. 3. Hydrocoele of the cord without an apparent hernia. (Courtesy of American Journal of Surgery.)

GASTROINTESTINAL TRACT

Hamilton J. B.: Gastric Volvulus and Other Abnormal Rotations of the Stomach. *Am J Surg* 915 54 30

Gastric volvulus is an abnormal rotation of the stomach. Schatzki and Simeone point out that any position change of the stomach must be some form of rotation and this per se is not necessarily volvulus. They cite as examples the high lying stomachs of obese individuals or the upside down appearance of the high stomach commonly associated with eventration of the diaphragm. However, true volvulus may occur in the presence of eventration.

True gastric volvulus is considered to be present when rotation of the stomach reaching or closely approximating 180 degrees is present. This spontaneously reduces itself or is reducible by manipulation. It can reasonably be assumed to be the result of injury. Other abnormal rotations which are not subject to reduction either spontaneously or manually are believed to be variations on a basis of congenital anomalies.

There is a conflicting terminology of classification of gastric volvulus. Singleton says that "gastric volvulus may be defined as an abnormal anterior or posterior rotation of almost all of the stomach about either the coronal or sagittal axis of the body." The stomach is limited in mobility between the gastrophrenic ligaments above and the peritoneum covering the second portion of the duodenum below. According to the length of the gastrophrenic omentum the stomach may be displaced within these limits by extrinsic pressure. Therefore, pressure displacement is very common but true rotation of the stomach is relatively rare and requires unusually long gastrophrenic and gastroduodenal mesenteries to allow its occurrence.

Singleton classes volvulus as

1. Organo-axial rotation of the stomach upward around the long axis of the stomach i.e. the coronal plane.

2. Mesenteroaxial rotation of the stomach from right to left or left to right, about the long axis of the gastrophrenic omentum. This second type is called torsion or twist of the stomach by others namely Becker, Shanks, Kerley and Twining.

In acute gastric volvulus the rotation is so great that the blood supply is disturbed and immediate surgery is indicated. A series of cases is presented with characteristic x-ray findings and interesting clinical pictures. One case was of a torsion type volvulus 6 cases were of the organo-axial type of volvulus 1 case was believed to be of the organo-axial type and 5 cases showed abnormal rotations which were constant and associated with eventration of the diaphragm. Acute gastric volvulus was not present in any of these cases.

In 1 case the excessive degree of twisting was shown by the pattern of the rugal folds and the bulb position. The spontaneous reduction was characteristic of a diagnosis of torsion volvulus. In obese

individuals a somewhat similar picture is presented by normal high-lying stomachs. This is differentiated from a torsion volvulus by the minor twisting of the rugal pattern and the normal bulb position. The difference between a gastric volvulus and a cascade stomach is emphasized.

Relaxed intra-abdominal attachments are believed to have been present in all cases presented. Obesity, trauma, marked weight loss preceding gastric rotation, and increased intra-abdominal pressure associated with obesity and anomalous development are some of the varying factors in the etiology of abnormal gastric rotations. A large redundant or abnormally situated colon was a feature in several cases of true volvulus. Eventration of the left hemidiaphragm was present in 3 cases and a true volvulus was associated with it in 1 case. Herniation of the diaphragm, 1 case due to trauma and 1 in an obese patient, was seen in 2 cases of volvulus. An unusual congenital variation, a thoracic stomach on the right side congenitally herniated through the foramen of Morgagni, was also reported.

Symptoms, while not characteristic, were present in all but 1 case. These were discomfort or pain in the epigastrium. Six patients had nausea and vomiting. Hematemesis and positive results of the benedictine test of the feces were found in 1 case. Only 3 patients had marked weight loss associated with gastric rotation. In several cases of true volvulus there was a history of similar attacks previously with a complete remission of the symptoms between the attacks.

The characteristic findings in various rotations of the stomach are described and illustrated. They are usually best seen in the upright posteroanterior position before the fluoroscopic screen. It is obvious that in cases of true volvulus the finding may be missed unless the patient is examined during an attack. The differential diagnosis between eventration and herniation of the diaphragm is important since in the presence of herniation a repair of the diaphragm may both relieve symptoms and cause the stomach to return to its normal position. In carefully selected cases it is possible that surgery may be helpful in restoring the stomach permanently to a normal position with relief of symptoms.

ROBERT E. BROWNE, M.D.

Orr T. G.: Pancreaticoduodenectomy for Carcinoma of the Ampulla and Ampullary Region. *Surgery* 1945 8 144.

Pancreaticoduodenectomy for carcinoma of the ampulla and ampullary region is discussed by Orr under six different headings. In addition, he has tabulated or listed the 33 additional cases reported in the literature from April 1, 1943 (date of Whipple's report) to November 1, 1944. In this listing he gives the author, the date reported, the age and sex of the patient, the type of operation, and the results.

The first of the six headings considers the diagnosis at operation. This may be most difficult because chronic pancreatitis or benign adenoma may



Codrill, 1938



Whipple, Parsons,
Mullins, 1935



Brunschwig 1937



Whipple 1938



Moreland, Freeman 1941



Hunt 1941



Trimble, Parsons,
Sherman 1941



Mangot 1941



Deans, 1943



Whipple, 1943



Phillips, 1943



Brunschwig, 1943



Cattell, 1943

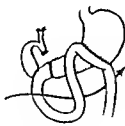


Poth, 1944



Watson, 1944

Sketches illustrating various techniques of pan-
creaticoduodenectomy



Child 1944



Child, 1944



Pickrell, Blalock, 1944

so closely simulate carcinoma that a diagnosis made by palpation alone may lead to a needlessly serious operation." In selected doubtful cases duodenotomy and biopsy of the papillary area may be indicated, or a biopsy of the lymph nodes or pancreas may be advisable. If the diagnosis is not clear after a biopsy of the papilla, lymph nodes or head of the pancreas, it is wise to plan the operation in two stages and complete the second stage after a positive diagnosis of operable carcinoma is made.

There has been no accurate publication of the final results of pancreaticoduodenectomy and until a careful study has been made, it will be difficult to state with any degree of accuracy what percentage of cures may result or what the average length of life

will be following this operation. It is also difficult at present to compare and draw conclusions from the results obtained by the palliative operation, the transduodenal resection, and the radical operation. But regardless of the lack of knowledge concerning the final results the radical excision of a carcinoma arising in the ampullary region by the Whipple type of operation fulfills the requirements of cancer surgery in general and offers the greatest hope for the greatest number of cures in the future.

3 After reviewing the experimental and some of the clinical reports on restoration of the external pancreatic secretion Orr asks "Is there any good reason why the end of the divided pancreas should not be united with the intestinal tract?" Then he

answers. Until this question can be answered an unqualified opinion concerning the advisability of restoration of the external pancreatic secretion following pancreaticoduodenectomy cannot be given. However one can state with assurance that it is a physiological procedure to restore the external pancreatic secretion of the intestinal tract.

4 The one-stage operation is preferable if the general condition of the patient will tolerate such an extensive and prolonged procedure with reasonable safety. The earlier that patients with perampullary carcinoma come to operation after the onset of symptoms the greater the number that will be suitable for the one-stage operation. There will be a relatively large percentage of deeply jaundiced and generally debilitated patients for whom the two-stage operation must be chosen. The first stage of the planned two-stage operation has a sufficiently high mortality to warn the surgeon that the choice of operation must be very carefully made.

5 The choice of technique should be guided by the fact that (1) sufficient tissue should be removed about the tumor to include any local infiltration of the tumor and the regional lymph nodes (2) the common duct should be used for anastomosis whenever possible instead of the gall bladder (this will facilitate drainage of the bile and prevent leakage of the bile from the ligated common duct) (3) the anastomoses between the gall tract and pancreas and the jejunum should be made proximal to the gastrojejunostomy to prevent infection of the gall tract and pancreas and (4) anastomosis of the pancreas to the jejunum should be made to prevent pancreatic fistula and to restore the external pancreatic secretion to the intestinal tract. These principles are incorporated in the operation of Whipple Poth, and Child.

6 The author has had 18 cases under personal observation. A study of these brought up the question of the possible operability and curability of such patients. To estimate the value of any operative treatment it is reasonable to include all patients having the disease. Of the first group of 9 patients 2 died following the first stage of the operation, and 1 died on the operating table at the beginning of the second stage. Two patients had palliative cholecystogastrostomies because of extensive metastases. A clinical diagnosis only was made in 3 cases. In only 1 of these was surgery recommended. Of the 18 patients 11 had proved metastases or clinical evidence of metastases. The frequency of metastases in this small number of cases makes one wonder just what percentage of such patients is curable by successful pancreaticoduodenectomy.

SURGEON J. FOGELSON, M.D.

Brandberg, R.: Obstruction following Gastric Resection and Gastroenterostomy. *Acta Chir Scand* 94: 93-97, 37.

Difficulty in emptying the stomach contents into the intestine occurs quite frequently after gastric resection and gastroenterostomy but, generally

recovery is spontaneous without any radical treatment. These temporary obstructions are due to gastroenteric atony. Other causes of obstruction are mechanical or due to distention peritons caused by the operation.

In resection by the Billroth I method, serious obstruction may be caused by distention of the stomach wall at the site of the suturing of the resected surfaces. Therefore this type of resection should be used in only a limited number of cases. The common cause of obstruction in antecolic loop gastroenterostomy with or without resection, is that too short a loop has been used for the gastroenterostomy and as a result the afferent loop becomes too much distended and, therefore, parietic. The stomach empties into this parietic loop while there is little or no emptying into the efferent loop. The loop in this type of gastroenterostomy should be at least 50 cm. long. The same cause may lead to obstruction in posterior short-loop gastroenterostomy with or without resection, but the commonest cause of obstruction in this type of operation is abnormal shortness, fibrous thickening, or high fat content of the mesocolon. This causes so much pressure on the gastroenterostomy loop that it cannot be overcome by the comparatively slight motility of the loop. If there has been a large resection the mesocolon may be pulled up so much that it compresses the gastroenterostomy loop and results in obstruction. All these changes cause distention and paresis of the afferent loop with the result that the stomach empties into the afferent instead of the efferent loop. Therefore, posterior gastroenterostomy should not be used unless the mesocolon is completely normal. If it shows any abnormality anterior gastroenterostomy should be performed. Severe obstruction can almost always be prevented by choosing the right type of gastroenterostomy.

If obstruction occurs after a few days of satisfactory emptying it is apt to be caused by inflammation or adhesions around the gastroenterostomy opening.

Temporary obstructions may be relieved by repeated washing of the stomach or permanent suction, associated with the parenteral administration of sodium chloride and glucose solutions, and in some cases the transfusion of blood. In severe and long-continued obstructions caused by distention peritons with changes in the mesocolon and the formation of adhesions a jejunostomy must be performed for the purpose of feeding the patient. In the majority of cases the obstruction is overcome spontaneously and it is not necessary to perform any of the operations for abolishing it. These operations are often complicated and show a high mortality.

AUDERT G. MORGAN, M.D.

Ten Kate J. The Technique of the Billroth I-Schoemaker Gastrostomy. *Acta Chir Scand* 94: 90-93.

Billroth performed the first successful resection of the stomach for cancer in 1881. In his first method,

called the Billroth I the duodenum was anastomosed to the stump of the stomach at the greater curvature, the part at the lesser curvature being closed. It was soon found that this method involved serious risks because of tension on the sutures particularly at the "fatal suture angle" where three sutures met. Billroth himself gave it up for his second method the Billroth II but Schoemaker modified the Billroth I method so as to free it of its greatest danger. He introduced a curviform incision of the stomach. The antrum is resected together with the greater part of the lesser curvature and the beginning of the duodenum; a tube is formed from the part of the stomach lying near the greater curvature. This is a radical method and yet it economizes normal gastric tissue. The gastric tube is long enough to be united to the duodenum without any tension. A special clamp to be used in the performance of the operation was devised. This clamp and the various steps of the method of operation are illustrated in the original article.

The author believes that with the Schoemaker modification the Billroth I method is possible in any gastrectomy. In penetrating duodenal ulcer with an infiltrated wall, the Billroth II method or a gastroenterostomy is preferable on account of the danger of recurrence. Modern surgical methods are determined more by physiological than by anatomical considerations and the author believes that Billroth himself would now use his first method of operation in preference to his second one.

ANNEX G MORRIS M.D.

Sanders, R. L.: A Review of 161 Subtotal Gastric Resections for Benign Ulcer. *Surgery* 1945 18 320

The 161 subtotal resections upon which this study is based were performed during the past 11 years from 1933 to 1944. There were 13 patients with gastric, or duodenal and gastric ulcers, 11 of whom were operated on from nine months to nine years ago. Ten, or 90 per cent, obtained a good functional result and were free from their former ulcer symptoms. The eleventh patient died of pulmonary embolism on the third postoperative day.

Of the 80 patients with uncomplicated duodenal ulcer 61 were operated upon primarily and in 19 the resection followed a previous operation for the same condition. Of the 61 with primary resections 1 died, a mortality of 1.7 per cent. This incidentally was the first patient of the series, who was operated upon in 1933. Of the remaining 60 patients 50 were operated upon more than one year ago and 48 of these have been heard from since. 33 reported an excellent result with good stomach function and complete relief of their distress; an additional 10 were materially relieved although they still have some minor disturbances such as mild nausea and vomiting after breakfast or some weakness or stubborn weight loss. These 43 patients thus represent 90 per cent of the results which may be classified as excellent or good. Four patients or approximately 8 per cent have clinical and roentgenographic evi-

dence of a recurrent ulcer at the stoma. Of the 19 who underwent secondary operations 16 came to surgery more than 1 year ago. Three of these have some slight nausea and the others report complete relief with a good functional result.

The remaining 8 cases were instances of gastrojejunal (6) and of colonic fistula complicating gastrojejunal ulcer (2). All of these patients were operated upon more than 1 year ago and 1 of the patients with a colonic fistula died. 6 patients have obtained an excellent result, having no symptoms and 1 patient has only occasional nausea. Therefore there were good results in 87.5 per cent of this group of 8 patients undergoing secondary operations and a total mortality of 3 deaths or approximately 3 per cent for the 101 resections. In view of the nature of the operation and the fact that many patients with these lesions have associated disease which materially increases the risk, these results are certainly commensurate with those of other abdominal procedures of similar magnitude and explain in part the continued and increasing preference for this type of operation in the conditions here reported. The author states that they have had no deaths resulting from the resections in these cases for the past 8½ years.

The author also classifies his patients into groups particularly his patients with primary resection for duodenal ulcer from the standpoint of the pathological condition found at operation and the relief to be expected from the operation. For instance, 17, or 34.7 per cent of the patients who were operated upon more than 1 year ago had a bleeding posterior ulcer (7 of them with an associated anterior ulcer). 13 of the 17 were completely relieved and 4 were partially relieved. Thus the entire 17 or 100 per cent were benefited by the operation. The second group consisted of 6 patients who underwent resection for pyloric obstruction, the usual pathology being a posterior duodenal ulcer of long standing although in 2 of the author's patients again there was present also an anterior ulcer. Five of these 6 patients have remained entirely free of symptoms after resection, but 1 still has some nausea with vomiting of bile at times. In the remaining group are 26 patients who underwent resection for intractable pain here again the causative factor seemed to have been a posterior duodenal ulcer eating its way into the pancreas; however in 16 of these cases an anterior ulcer was present as a complication. Of these 26 patients 15 were completely relieved and 5 partially relieved. 4 continued to have considerable discomfort, 1 developed clinical evidence of a gastrojejunal ulcer and 1 died.

Although this series is small it shows that the author's experience is similar to that of other surgeons in that obstructive ulcers of the duodenum have been found most amenable to cure that resection for bleeding ulcer may be expected to give the next best results and that the prospect of complete relief is somewhat less certain for intractable ulcers.

JOHN W. BERNHARD M.D.

Luna D F., and Arzede, F C.: Healing of Tuberculous Ulcers of the Intestine (Curación de las úlceras tuberculosas del intestino) *Rev As med argen* 945 59 634.

About 19 per cent of tuberculous patients die of intestinal lesions which complicate the pulmonary disease. It is therefore, of great importance to cure the intestinal lesions. They begin as a submucous tubercle which undergoes caseation softens empties into the lumen of the intestine, and leaves an ulcer. They are called simple ulcers if they affect only the submucosa penetrating if they affect the muscular layer and perforating if they reach the subserosa. Naturally the shallower they are the more readily they heal. It has been shown that spontaneous healing does occur. The stages in healing are granulation of the ulcers and epithelization. Sometimes new epithelium is produced in excreta. If muscle has been destroyed it is never regenerated. Even if the ulcers heal, a break in the continuity remains in the muscularis mucosae marking the original extent of the ulcer and a gap in the muscle layer which is filled with connective tissue. Stenosis from contraction of ulcers has been reported but the authors did not see any cases of it in 730 autopsies 450 of which were performed systematically in a search for such lesions. Among these 18 ulcers in the process of healing were found.

A detailed histological description is given of the different stages of healing and illustrated with photographs of the surgical specimens and photomicrographs of the histological findings. The process of healing may be hastened by various treatments such as ultraviolet rays and cod-liver oil and orange juice. Spencer Wells was mistaken in reporting that these ulcers could be healed by exposure to air. He based this statement on a simple exploratory laparotomy in a case of tuberculous ulcers of the intestine after which the ulcers healed.

AUDREY G. MORAGAN M.D.

Kock W. Primary Sarcoma of the Small Intestine (Primäres Duodenalcarcinom) *Id. Zt. f. Chir.* 1943 50 37.

Seventeen sarcomas of the small intestine are reported from the records of the large surgical clinics in Stockholm covering the years 1900 to 1941. Most of these tumors were undiagnosed until uncovered by autopsy or operation. However, in 8 patients a tumor could be determined by palpation or with x-rays.

The first of these preoperatively diagnosed cases was that of a boy of 16 years who had suffered for almost a year of recurring attacks of abdominal pain and distention, dyspepsia and anorexia. Physical examination in this instance disclosed large areas of localized resistance with knobby extensile upward toward the liver.

The second example was that of a soldier of 42 years who had suffered for about 2 years with attacks of colic, constipation and flatulence, and frequent attacks of dysuria. He himself had noted a

knob the size of a goose egg, in the right iliac region, and on physical examination there was palpable a mass the size of 2 fists extending from the symphysis to the navel.

The third patient, a man of 27 years had symptoms which began as attacks of colic and diarrhea with loss of weight. Later there was detectable in the right side of the abdomen a rapidly growing tumor.

The fourth patient a female of 66 years had always been anemic and 4 years previously had had attacks of diarrhea. A year previously she had suffered fever, vomiting, colicky pains, and meteorism. Since then there had been attacks of persistent diarrhea, the patient had become pale and cachectic, and the stools evil smelling. Examination in this instance disclosed a mild anemia, eosinophilia, and an occasional positive Weber reaction. The right hypochondrium looked fuller than the left, and dilated loops of bowel could be palpated. Roentgenological examination in 1930 the first in this series of 8 patients wherein the x-rays were mentioned showed a walnut-sized shadow defect on the border between the rectum and sigmoid. With oral administration of the contrast medium there was disclosed a delayed, obstructed emptying of the small bowel and adhesions between loops of the small intestine.

The fifth clinically diagnosed patient a 51-year old female had suffered acid eructations for many years and for the past few weeks had been unable to tolerate highly seasoned and fatty foods—she had experienced frequent attacks of postprandial vomiting and colicky pains from 4 to 5 hours after eating. She had lost much weight in the last half year. A week previously this patient had noted a plum-sized, painless mass alongside of the navel. Examination disclosed a subfebrile temperature and indication of a defense musculature in the right epigastrium. There was a palpable 1 cm plum-sized mass near the navel which seemed adherent to the linea alba. X-rays revealed organic changes in the cecal pole and in the region of the ileal anastomosis into the cecum. Here the diagnosis was not decisive as between inflammation or tumor but operation confirmed the presence of a tumor which was clinically diagnosed as a sarcoma of the small bowel. In this case as in 3 others of this series the diagnosis was not confirmed by microscopic examination of the operative or postmortem specimens.

The sixth instance was that of a female 59 years of age whose case was previously reported by Bl. G. Nilsson (*Id. Zt. f. Chir.* 1933 73 34 576) and who had suffered vague abdominal pains. The tentative diagnosis of tumor of the small intestine was based solely on the roentgen findings.

The seventh case was that of a 60-year-old widow who had suffered for several years with marked flatulence and colic. During the previous several weeks these symptoms had become worse and a medical clinic had made a tentative diagnosis of appendicitis. Examination disclosed anemias, a slightly distended abdomen, and rectal findings sug-

going a tumor of the adnexae on the right side of the colon (possibly merely scybala). X-ray examination, however, gave the findings of a space limiting process beneath and medial to the cecal pole.

The eighth example was that of a male of 72 years who had suffered weakness and loss of weight for 3 months before the tumor in the right iliac fossa was noted since then he suffered at times of meteorism with abdominal distention. The roentgen examination disclosed an infiltration of the wall of the cecum which was regarded as definitely carcinomatous however the pathologicoanatomic diagnosis was lymphosarcoma.

In the remaining 9 patients in this series of small intestinal sarcomas, the symptoms and findings were not greatly different from those of the 8 clinically diagnosed instances cited and indeed not greatly different from those postulated by the world literature on the subject. However all 17 cases are lumped together by the author in an attempt to secure information on the frequency of primary sarcomas of the small intestine in proportion to other malignancies of this region. For instance during the same period (from 1900 to 1941) there were also brought to operation in the surgical clinics of Stockholm, 23 instances of sarcoma of the stomach and 5 cases of sarcoma of the colon—together with a patient in whom a growth involving both the stomach and the colon was uncovered. As regards the incidence with reference to the different sections of the small intestine itself there were 2 tumors involving the duodenum, 2 involving the jejunum, 3 in the ileum, 3 in the ileocecal region, and 7 reported for the small intestine as a whole. There were no instances reported from the children's departments of the Stockholm hospitals the patients being otherwise fairly well distributed for age.

Histopathological examination was reported in 10 of these 17 patients and the pathologicoanatomical findings revealed were the following: 1 round-cell sarcoma of the large-cell type, 2 round-cell sarcomas of the small-cell type, 1 fibrosarcoma of the giant-cell type, 1 myoma sarcomatodes, 1 sarcoma of the reticulum-cell type, 1 hemangiosarcoma and 3 lymphosarcomas.

The data from this material is included in a table showing the surgical methods employed. These methods varied according to the exigencies of the individual situation encountered and the results of such treatment. The results are not especially encouraging and have apparently not improved greatly during the period covered by this report. The author stresses the importance of preoperative and postoperative irradiation treatment none of these patients however were treated by irradiation method prior to surgical intervention and the postoperative applications are not claimed by the author to have produced any markedly beneficial effects. Except for the roentgenological advances the whole subject appears to have remained about where it was a half century ago.

JOHN W. BRENNAN, M.D.

Arendt, J. The Significance of Cannon's Point in the Normal and Abnormal Functions of the Colon. *Am J Roentg* 1945 54 149

The author has noted that frequently twenty-four hours after the ingestion of barium and sometimes immediately after the expulsion of barium enemas the colonic pattern is divided into two distinct parts so that either the cecum, ascending colon and proximal portion of the transverse colon are widely filled with barium while the distal portion of the colon is contracted (Fig. 1) or vice versa. Occasionally however only a contraction ring was noted in the transverse colon. The site of the change from the wide lumen to the contracted one or the site of the contraction ring was usually to the right of the spine between the proximal and middle thirds of the transverse colon, and never much further distal than the middle third. The constancy of the phenomenon has convinced the author that this point is of great functional significance.

He identifies this point with that of the contraction ring described by Cannon in cats, in 1902 and later in rabbits and in man by Boehm who also observed different functions on the two sides: tonic



Fig. Denarcation of Cannon's point (arrow). Ascending and transverse colon wide up to Cannon's point; transverse and descending colon contracted beginning at this point.

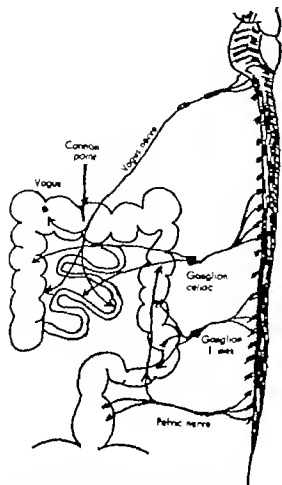


Fig. 2 Schematic drawing of the co-ordinated or at times antagonistic colon innervation.

contraction and antiperistalsis in the proximal part of the colon, and deep segmentation with haustration in the distal part. A diagram by Garry showing the functional division of the colon at Cannon's point as established in animals by the experimental physiologists is reproduced and Case's early roentgen study of colon motility in man is recalled.

The author's contribution is his hypothesis that Cannon's point represents the pivoting point of a change in extrinsic innervation of the colon between the vagus and pelvic nerves on the parasympathetic side and on the sympathetic side between the splanchnic superior and inferior nerves (Fig. 2). The precise point where such change occurs has long been in question although the general distribution in the colon of innervation from the various extrinsic sources is well known. The point of change proposed follows well the colonic division as to the blood supply the proximal neurological unit of the colon being supplied by the superior mesenteric artery and the distal part by the inferior mesenteric artery.

If the nerve impulse in ascendancy is the same type in both neurological divisions of the colon, no

demarcation of the two units can be seen roentgenologically but if they are antagonistic, the division is clearly visible. At Cannon's point peristaltic waves tend to flatten out or reverse themselves, the proximal part of the colon being the relatively quiet portion, while beyond Cannon's point the great driving movements have their origin.

The author finds this concept of functional antagonism clinically significant, in that spastic contraction of the distal unit may be a cause of constipation in the ascending colon, and hence best treated by antispasmodics. It also offers an explanation of the observations of Mony and Vernet that kidney stones are often accompanied by painful spasm of the descending and transverse colon with constipation, because of reflex blocking of the distal neurological colonic unit due to the close association of its innervation and that of the urinary tract. Study of the neurological units of the colon has importance also in the differentiation of, and choice of operative method for the different types of megacolon.

LILLIAN DONALDSON, M.D.

Farkas, J. V. Acute Appendicitis. *Minnesota M.* 945 3 35

Farkas analyzes 665 cases of acute appendicitis admitted to the Surgical Service of the Minneapolis General Hospital over a five year period. All are cases of grossly and microscopically proved diseased appendix vermiformis.

The ages of the patients ranged from two to seventy-six years. There were 354 males (53.2 per cent) and 311 females (46.8 per cent). Despite this inequality in the overall figures there was a greater incidence of the disease in females in the earlier periods of life.

There were two definite seasonal peaks, one in midwinter and one in midsummer.

The duration of symptoms ranged from one and one-half hours to seventeen days according to whether the appendix had not perforated (average 25.6 hours) had perforated (average 49.05 hours) or whether there was a definable mass present (average 6.4 days).

Six hundred and forty-eight patients were treated surgically. Of the remaining 17 patients, 15 had definable masses and the disease apparently was under adequate control, 1 was an eleven-year-old girl who was extremely ill, with a temperature of 104° who expired after three days of hospitalization and the last was a seventy-six year-old man who was admitted to the hospital in a moribund state and expired the same day.

A McBurney incision was done in 524 cases and a rectus muscle approach was used in 140 instances 79 of the patients in this group were females.

The stump of the appendix was inverted in less than half of the cases, and apparently there was no difference postoperatively between those patients in whom this technique was employed and those in whom it was not utilized.

Only in cases with abscess formation were drains used. Sulfonamides given orally or intravenously

were administered postoperatively in full therapeutic doses to patients with evidence of peritonitis.

It is believed that the use of morphine prior to surgery was a helpful aid in interpretation of the true pathological state because of the elimination of muscle spasm.

Spinal anesthesia was the method of choice.

The hospital stay varied with the type of incision. Following the McBurney incision it averaged seven and three tenths days and following the rectus incision, eleven and three tenths days, whereas patients with perforation of the appendix were required to remain for an average of nineteen and four tenths days.

Bacteriological studies when done were not remarkable, the usual intestinal inhabitants (*Escherichia communis*, *Escherichia communior* and non hemolytic streptococci) being found.

There were 13 (1.94 per cent) deaths, 11 (1.65 per cent) of which occurred postoperatively. All of the latter occurred in patients who had had perforated acutely infected appendixes and generalized peritonitis.

Postoperative complications other than urinary retention included pulmonary atelectasis, subphrenic abscess, wound infections, postoperative wound eversion, and 1 large pelvic abscess. There were other complications which were not postoperative such as acute appendicitis complicating pregnancy, acute appendicitis complicating the puerperium, and Meckel's diverticula. There were no deaths among this group of patients.

STEPHEN L. ZISKIN, M.D.

O'Connor, H. A. D. and Beale, E. M. Appendicitis: A Survey of the Last 2,000 Consecutive Cases. *J. Ark. State J. M.* 1945 45: 1535.

The entire series of cases presented is taken from the service of the senior author at the Brooklyn Naval Hospital and constitutes a completely unselected group of 2,000 consecutive patients operated upon for appendicitis from October 1942 to September 1944. The preoperative care, anesthesia, operative technique and postoperative management are described in detail.

The authors believe that in these cases more attention should be paid to the history and less to the physical findings and laboratory reports and that appendectomy should be done on the suspicion of appendicitis rather than on the established diagnosis. They recommend the free exhibition of the sulfonamides in adequate dosage given intraperitoneally with liberal use of the Wangensteen type of gastric drainage and of intravenous fluids and the adoption of an operative technique which make appendectomy relatively safe and simple even for the tyro.

ERIC C. ROSENBERG, M.D.

Ochsner, A. and Johnston, J. H. Appendicitis Peritonitis. *Surgery* 1945 17: 873.

Cases of ruptured appendicitis admitted to the Charity Hospital, New Orleans in 1933 and 1934

were studied and analyzed. These two years a decade apart were chosen because in the former group no sulfonamide drugs were employed, no attention was paid to plasma proteins, and gastrointestinal decompression was inadequately used. The cases were classified in three groups in accordance with the type of complication associated with rupture of the appendix as follows: (1) generalized peritonitis, (2) localized peritonitis, and (3) localized abscess.

The incidence of localized peritonitis was about the same in the two groups, while the incidence of generalized peritonitis decreased and that of localized abscess increased in the 1934 group. A comparison of the treatment and results in the years of 1933 and 1934 indicates that the therapy now employed is more effective than that which was used formerly.

The use of sulfonamides has been a boon in lowering the mortality and the morbidity, but the use of large amounts of blood and plasma, the employment of gastrointestinal decompression, and the use of oxygen have been equally important. The combined mortality rate in all types of appendical peritonitis in the 1933 series was 15 per cent, and in the 1934 series was 5.2 per cent. In 20 patients with localized peritonitis admitted in 1934 there were no deaths in contrast to a mortality rate of 13.4 per cent in the 1933 series. In the patients with generalized peritonitis the mortality rate in the 1933 group was 23.5 per cent, whereas in the 1934 group it was 14.2 per cent. There was no significant variation in the mortality rate for patients with localized abscess in the two series. The lack of improvement in the mortality statistics in cases of localized abscess is probably due to the ineffectuality of the sulfonamide drugs in localized suppurative processes. These statistics demonstrate the necessity of instituting drainage of localized collections of pus before sulfonamide drugs can be effectual.

A plea is made for careful study and individualization in every case of appendical peritonitis. The authors advocate (a) immediate appendectomy in all cases of unruptured appendicitis, (b) immediate appendectomy in all patients with ruptured appendicitis in whom there is not definite and demonstrable localization (thus, they believe in immediate appendectomy in the localized and generalized peritonitis cases of the diffuse type) and (c) conservative therapy in all cases of localized inflammatory processes. This treatment consists essentially of obtaining absolute rest of the gastrointestinal tract by withholding everything by mouth, the liberal use of morphine, the application of external heat to the abdomen, gastrointestinal decompression, the liberal use of blood and plasma to avoid anemia and hypoproteinemia, parenteral administration of sulfonamide drugs, and oxygen to aid in preventing distention. The authors believe that in 75 to 80 per cent of such cases the inflammatory process will quickly recede and that interval appendectomy should be done at a later date. In from 20 to 25 per cent of such cases localized suppuration

will occur and will require drainage. Great care in avoiding uninvolved peritoneum in such drainage is imperative.
 Jon I. Lindquist, M.D.

Wiklander O. Rectal Prolapse in Children. *Acta chir scand.* 945, 92, 7.

Rectal prolapse is much more frequent in children than in adults. Almost 90 per cent of the cases occur in children. The prolapse generally begins during the second year of life and there is a tendency toward spontaneous healing.

The author discusses 48 cases treated from 1932 to 1942. About two-thirds of the cases occurred in boys. Constipation is an important contributory cause having been seen in more than 50 per cent of the cases. However, not enough attention has been paid to poor social and economic conditions in the causation of this condition. The majority of these children came from poor homes in which they had been neglected and in more than half of the cases re-examined, treatment had been inadequate.

Because of the tendency toward spontaneous healing, treatment should at first be conservative. The child is kept in bed, the diet regulated, and complete abdominal pressure is avoided by allowing the child to defecate while lying down or sitting on a vessel with his legs hanging. If conservative methods do not give good results or if there is fear of recurrence from neglect after the child goes home, operation may be used, although conservative treatment should be prolonged for at least a month before surgery is used.

The surgical methods most in use are those of Thiersen and Ekeborn and stripping by diathermy. The results obtained by stripping are as good as those from the other methods, as permanent healing takes place in from 85 to 90 per cent of the cases. Stripping is recommended as the simplest and least dangerous surgical method. The prolapse is pulled forward and after about 6 longitudinal stripes are cauterized they are sutured along the prolapse with a diathermy bulb up to and particularly at the transition to the skin. Then the prolapse is reduced and the child kept in bed for a week on a laxative diet. If only longitudinal stripes are sutured with a distance of a or 3 cm. between them there is no danger of stricture.

Audrey G. Morgan, M.D.

Blalodell, P. C.: Traumatic Injuries of the Rectum. *J Am M Ass.* 945, 28, 559.

Rectal injuries commonly result in perineal complications due to the fact that these wounds tend to become fistulous. The less a lacerated wound approximates a penetrating one, the less likely it is to become a fistula. The primary suturing of traumatic rectal wounds constitutes potentially the most serious violation of principle. It has been proved that healing has been delayed far beyond that of wounds left wide open from the start. Primary suturing may be responsible for fistulas which are totally incurable or an operation necessitating far greater mutilation for cure than if the wound was

left open. Acute abscesses are a frequent intermediary stage between either a closed or a bridged wound and the final chronic fistula. This extension of pus under pressure may expand many times the limits of the original injury. The danger of incontinence by the prolonged separation of muscle ends through continued packing of the wound must be considered.

In injuries to the anal sphincter it is found that when the severed ends are left apart and no effort is made to bring them together, this area must be watched for bridging. It is believed that the traumatically injured sphincter should be left alone to take full advantage of its own capacity for spontaneous recovery.

A colostomy is not a preventive of fistula. Subsequent unsmooth healing is due primarily to faulty wound architecture which is shown by the fact that the recurrence rate is so times greater in sutured than in open wounds. In the treatment of the intermediary abscesses the site of incision itself becomes part of the residual fistula.

Four cases of traumatic injury to the rectum are presented in abstract form, and in 3 cases mismanagement is charged.

RICHARD J. BENNETT, JR., M.D.

LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

Zachos, A.: Uremia in Lesions of the Liver and Bile Ducts. *Acta chir scand.*, 943, 28, 383.

It has long been known that there is decreased diuresis in patients with liver disease. About the middle of the last century attention was called to the fact that in patients who had died from some forms of liver disease there were also lesions of the kidneys which were considered secondary to the liver lesions. Not only retention of water is found, but also increased blood urea, acidosis, and the presence of parenchymatous lesions of the kidneys, although the latter may be slight. Such lesions occur not only in liver disease but also after operations on the bile ducts more frequently than has been believed. In severe cases the patient may die with the clinical picture of uremia.

Thirteen cases of uremia occurring in diseases of the liver and bile ducts are described. Tables and graphs in the original article show the course of the disease. Treatment must be directed toward improvement of the function of the liver and also of the kidneys, particularly toward increased diuresis. Careful examination should be made before any proposed operation on the liver or bile ducts is performed, and if kidney function tests are unsatisfactory operation should not be performed. After operation, shock should be combated by blood transfusion. The patient who has had an extensive operation requires about 3 or 4 liters of water in 24 hours, which should be given him by mouth as soon as he is able to drink. Glucose also should be given after the operation. Excessive use of salt solution

may cause edema even edema of the lungs. If there is acidosis an isotonic sodium bicarbonate solution should be given at once. Intravenous or subcutaneous.

The prognosis is bad. Only 2 of the patients in this series recovered. It is possible that some of the others might have been saved if treatment had been given in time.

ANDREW G. MORGAN, M.D.

Narat, J. K., and Cipolla, A. F.: The Fragmentation and Dissolution of Gall Stones by Chloroform. *Arch Surg* 1945 51: 51.

As a rule, mechanical means are sufficient for the removal of stones from the biliary tract. Therefore the field of usefulness of a chemical solvent is so limited that only two indications can be suggested:

1. When a stone is firmly lodged in the common duct and cannot be removed manually when the surgeon is not certain that all broken particles of the stone have been removed, or if the stone is firmly lodged close to the ampulla of Vater, the use of a solvent may obviate the necessity of opening the duodenum.

2. When a stone in the hepatic duct slips away into the liver in the course of attempts to remove it mechanically.

In such circumstances injections of heated chloroform may be given a trial because this method apparently does not represent a therapeutic hazard. To play safe it is advisable to use not more than 5 or 6 c.c. of the solvent and to pinch the hepatic duct during the procedure. In experiments in vitro as well as on animals the use of heated chloroform proved to be superior to ether as an efficient solvent of gallstones.

Repeated injections of chloroform during the post-operative period should be discouraged because they are not efficient and represent a potential hazard.

S. RUTH KARY, M.D.

Voelz, E. F.: Four Cases of Acute Pancreatitis in Previously Cholecystectomized Patients. Remarks Concerning Recurrences in 46 Cases of Acute Pancreatitis (Vier Fälle von akuter Pancreatitis bei vorher cholecystektomierten Patienten. Einiges ueber Rezidive in einem Material von 46 akuten Pancreatitis-fällen). *Acta chir scand* 1943 85: 250.

At the time when radical treatment of pancreatitis was popular it was customary to remove the gall bladder in the course of the operation because gall stones undoubtedly represent the most frequent cause of pancreatitis. Cholecystectomy had the purpose of speeding up the recovery and preventing recurrences. Removal of the gall bladder was also advised in each case of cholelithiasis to prevent the development of pancreatitis. However numerous observations showed that the expected results were not always achieved.

The author reports 4 cases of acute pancreatitis in patients in whom the gall bladder had been removed from 1½ to 4 years previously. He also reports 46 cases of acute pancreatitis. The material is divided into two groups: cases treated in a conservative manner and cases treated by cholecystectomy. In the last mentioned group the operation was performed on 4 patients during an acute attack and on 3 patients during the interval. Two patients who were operated on during the attack developed recurrences. In 23 patients treated in a conservative manner the condition became chronic and in 7 it recurred. The author concludes that no great difference existed between both groups as far as development of chronicity or recurrences was concerned.

The author realizes that his material is too small to allow any definite conclusions, but nevertheless he is inclined to believe that cholecystectomy has no great prophylactic value in the prevention of acute pancreatitis.

JOSEPH K. NARAT, M.D.

OBSTETRICS

PREGNANCY AND ITS COMPLICATIONS

Zondek, B. Sulman F. and Black, R.: *Hormone Pregnancy Test J Am M 12 1945 1: 950*

In an effort to determine a more rapid pregnancy test the authors have worked with infantile female rats from three to five weeks old and weighing from 20 to 25 gm. They have discovered that the hyperemia hormone pregnancy test is 100 per cent accurate in a twenty-four hour reading for the determination of pregnancy, but it is not as yet sufficient for the diagnosis of disturbed pregnancy which includes ruptured extrauterine pregnancy and threatened incomplete and missed abortion. There may be a 1 per cent error due to tumors in nonpregnant individuals. The two- and six-hour tests can be relied on if the results are positive.

The hormone pregnancy test is based on the following gonadotropic reactions of the ovary in infantile rodents: anterior pituitary reaction I (follicle ripening and induction of vaginal estrus) anterior pituitary reaction II (hyperemia of the ovary and follicle hemorrhage) anterior pituitary reaction III (the formation of corpora lutea).

In developing the pregnancy test it was found that only anterior pituitary reactions II and III may be used for an accurate evaluation of the test despite the presence of large amounts of the lutealizing hormone indicates pregnancy. Infantile mice were first used because of the ease of finding the blood dot, but this method takes four days. Friedman next used rabbit, but this requires well organized breeding, separation of the rabbits for four weeks and in the subtropical climate of Egypt false positives were obtained. If the blood dot is to be used as the indicator for gonadotropins, the mouse or rabbit is most suitable, whereas if hyperemia is to be used the rat is most fitting.

The authors designated a hyperemia unit as the amount of gonadotropic hormone which induces hyperemia of the whole ovary in an infantile rat within twenty-four hours. Hyperemia is evoked mainly by luteinizing hormone and follicle stimulating hormone has only an augmentative effect. For the exact diagnosis of pregnancy the right dosage is important since the injection exceeds a certain amount.

Urine results in positive reactions in nonpregnant women with functional disturbances. The most practical dose was found to be 4 c.c. in two subcutaneous injections of 2 c.c. in an interval of one hour. If the reaction is positive, the ovaries appear slightly brighter than the spleen, a saline, pearl-strawberry red. This test can also be used for the diagnosis of hydatidiform mole and chorionepithelioma. In the latter a gray vesicle is obtained with 0.0003 c.c. of urine.

The investigators have found therefore that the hyperemia test is sufficient when it is a question of

the simple determination of pregnancy. If there is a suspicion of disturbed pregnancy, such as bleeding of uncertain cause, the ordinary hormone pregnancy test cannot be dispensed with. Then at present developing the follicle-stimulating hormone (FSH) test in the rat so that in the future the rat test may also be used in cases of disturbed pregnancy.

CASE 31 BY B. J. S. M.D.

Siegler, S. L.: *An Evaluation of Ectopic Pregnancy with Selective Data from 327 Consecutive Cases. J Ark State J M 1945 45: 194*

The author evaluates 127 consecutive cases of ectopic pregnancy during a period of 15 years at the Units Hospital, Brooklyn, New York. There was an incidence of 2.3 per cent ectopic pregnancy in gynecologic admissions. 8.1 per 1,000 pregnancies or an incidence of 1 ectopic pregnancy to 123.4 pregnancies occurred.

In 24.5 per cent of the patients the ectopic pregnancy occurred as the first pregnancy. 33.0 per cent had had 1 preceding pregnancy. 26.8 per cent had had 2 previous pregnancies and 14.8 per cent of the patients had had from 3 to 6 previous pregnancies. Repeated abortions increased greatly the incidence of ectopic pregnancy. A relatively sterile period of 5 years or more preceded the abnormal pregnancy in more than two-thirds of the cases.

The author states that the etiology probably varies greatly. It may be ovular disturbance, implantation, or mechanical. The residual of pelvic inflammation, disease, appendicitis and other previous operations were factors in 78 per cent of the cases. Three cases occurred following tubal insufflation following tubal occlusion.

The symptomatology was variable, especially with regard to the type of pain which was sharp and stabbing, or dull and colicky. In 89 per cent of the patients the first complaint was pain. Atypical vaginal bleeding was seen in 87 per cent of the patients and consisted of menses occurring at the normal time but prolonged, menses at the normal time but diminished, menses delayed several days or weeks and those patients in whom there was no bleeding until the onset of their symptoms. Twenty-four per cent of patients had nausea and vomiting.

The physical findings showed abdominal tenderness in 90 per cent of cases, a tender cervix and palpable adnexal masses were found in 92 per cent of patients.

History and physical findings in the diagnosis. The biologic test was done 5 times and was of doubtful value in the nonpregnant case for differential diagnosis.

The author believes that curettage has a select but limited value in diagnosis. The microscopic finding of decidual reaction is not a positive indication of ectopic gestation and conversely it does not

does not give proof of its presence. The finding of chorionic villi gives evidence of an intrauterine pregnancy. In 3 cases in which Friedman test was positive the curettings showed proliferative endometrium in 1 case hyperplastic endometrium in 1 case and decidual reaction in 1 case.

At operation 48 per cent of cases were found to be ruptured tubal pregnancies 35 per cent were tubal abortions and 13 per cent were unruptured tubal pregnancies. In 48 per cent of the cases the condition occurred on the right side and in 45 per cent on the left side. The appendix was removed in 36 cases with 2 resultant deaths. General anesthesia was the anesthetic of choice.

The author believes that a large number of patients can be saved before a state of irreversible shock sets in by prompt and massive transfusions of blood plasma or whole blood.

There were 5 deaths with a surgical mortality of 3.1 per cent. CATHERINE B. HESS, M.D.

Bowles, H. E.: Cervical Pregnancy. *West J Surg* 1945 53 226

Cervical pregnancy is extremely rare. The author presents a review of all of the cases in the literature (54) with the available data in each case. The one argument in the diagnosis of each case is as to whether it is a cervical abortion or a true cervical nidation.

The etiological factors are discussed. Retention of a previously detached ovum is favored by a stenosis of the outermost portion of the cervix. The pathological evidence of a true cervical implantation is also reviewed.

Cervical pregnancy is a formidable condition accompanied by a high maternal death rate and also a high fetal death rate when the fetus develops to the stage of viability. The diagnosis is based upon painless and copious bleeding in the presence of a markedly ballooned-out lower uterine segment.

The treatment of this condition depends on the stage at which it is first diagnosed. Emphasis is placed on extreme gentleness as the cervix is often paper thin and may tear extensively with even moderate roughness. Every form of supportive treatment must be available.

In early cases enucleation with a gloved finger or with placental forceps has been suggested. In several cases ligation of the lower branches of the uterine vessels was done to control the profuse bleeding. Vaginal hysterectomy may be done if necessary to control the bleeding if this is not possible abdominal hysterectomy may be resorted to. The cervix should be removed but if this seems inadvisable a supravaginal hysterectomy and firm packing of the cervix may suffice. In late pregnancy abdominal caesarean section seems the logical means of approach, with the liberal use of sulfonamides and penicillin.

The author reports a case of cervical pregnancy at 4½ months gestation treated by supravaginal hysterectomy with recovery. HARRY FIELD, M.D.

Andros, G. J.: The Blood Pressure in Normal Pregnancy. *Am J Obst* 1945 50 300

In the study of 300 cases of normal pregnancy followed through three trimesters it has been found that the systolic blood pressure does not vary significantly during any period of gestation, nor does it deviate from what might be considered normal systolic blood pressure for healthy nonpregnant women.

There is evidence that diastolic blood pressure tends to be slightly lower in the first and second trimesters of normal pregnancy than in the normal nonpregnant state.

On the basis of this study it would appear that any persistent even though slight increase in either systolic or diastolic pressure during pregnancy should be looked upon as potentially significant.

EDWARD L. CORNWELL, M.D.

Wilson, J. R.: Carcinoma of the Cervix Complicated by Pregnancy. *Am J Obst* 1945 50 275

Since 1931 6 patients with carcinoma of the cervix, complicated by pregnancy, have been treated at the Chicago Lying in Hospital. Of these 2 were referred to the hospital for treatment after the diagnosis had been made elsewhere. During this same period a total of 39,719 patients have been delivered thus the incidence of cervical carcinoma is 1 in each 6,600 deliveries or 0.015 per cent. All of the lesions were of squamous-cell origin with the exception of 1 which was an adenocarcinoma.

The existence of pregnancy and carcinoma of the cervix together is unusual and presents a difficult problem in therapy but an unusual opportunity to treat early lesions may present itself. The prompt and thorough investigation of bleeding during pregnancy is an important step in diagnosing the condition and may be responsible for saving the life of the patient. In most instances radical surgical procedures have no place in treatment since the results from combined irradiation are equally as good. A high fetal mortality is inevitable since it is usually unwise to resort to methods of treatment which attempt to preserve the fetus but which may decrease the chances for cure of the neoplasm.

Of the 3 patients in this series who were eligible for consideration 2 (67 per cent) survived longer than 5 years after treatment only 1 however is free from evidence of carcinoma.

EDWARD L. CORNWELL, M.D.

LABOR AND ITS COMPLICATIONS

Johnson, H. W.: The Conservative Management of Some Varieties of Placenta Previa. *Am J Obst* 1945 50 348.

It is suggested that obstetric textbooks be revised as regards maternal prognosis in placenta previa. The author has seen no maternal death from placenta previa where nature has been allowed to take its course as regards labor and delivery. He believes that all cases of vaginal bleeding in the last trimester

There was only 1 gross infection in the entire series and 1 complete breakdown. The latter occurred in a median perineotomy wound with third-degree extension which became grossly infected subsequent to the employment of local anesthesia.

EDWARD L. CORNELL, M.D.

NEWBORN

Schmitz, H. E., and Babo, G.: Aquinone during Labor: Its Effect on the Prothrombin Level of the Newborn Infant. *Am J Obst* 1945 50 20

A total of 23 unselected cases of newborn infants was investigated. They were classified according to whether the laboring mother had received no medication, some form of analgesia (usually cycloal sodium), both analgesia and aquinone or only aquinone. The percentage of cases which remained above the 75 per cent minimum prothrombin level was as follows: no medication 63 per cent, analgesia alone 50 per cent, both analgesia and aquinone 84 per cent, aquinone alone 90 per cent. Even more significant was the percentage of cases falling below the 70 per cent level, since many clinicians consider values below this level to be an indication for vitamin K therapy (in diseases accompanied by prothrombinemia) and values below 40 per cent as lethal in the danger zone. In cases in which no aquinone was used the percentages were 30 per cent and 41 per cent for the no medication group and the analgesic only group respectively, while in cases in which the aquinone was used the percentages were 8 and 0 for the 'aquinone-analgesic' group and the aquinone alone group respectively.

In this small series of cases no definite conclusion could be drawn nevertheless certain incidental observations are set forth. Icterus of varying degree was frequently seen in spite of the high normal prothrombin level (over 92 per cent). In some cases the icterus was quite marked in spite of the normal clotting time. On the other hand, other cases with a prothrombin level below 40 per cent manifested no icterus. (See also L. CORNELL, M.D.)

Linn, K. T. and Snyder, F. F.: The Effect of Respiratory Stimulants in the Newborn Infant. *Am J Obst* 1945 50 40

In newborn rabbit significant stimulation (respiration was difficult to demonstrate) following alpha lobeline, coramine or caffeine and following metrazol or cyanide the slight stimulation was transient and lasted less than a minute.

A considerable hazard involved in the use of these drugs was found to be the narrow range between the dosage which affected respiration and that which caused convulsions. Two or three times the effective dose usually resulted in convulsions in animals which had received pentobarbital premedication.

Injury resulting in death frequently followed convulsions which occurred after alpha lobeline, coramine, and caffeine. Survival occurred after metrazol and cyanide despite the occurrence of convulsions.

The present experiments lend no support to the use of alpha lobeline, coramine, caffeine, metrazol or cyanide in the resuscitation of the newborn infant.

EDWARD L. CORNELL, M.D.

Morison, J. E.: Thrombosis of the Aorta in the Newborn: 3 Cases, 1 with Infarction of the Liver. *J Path Bact Lond* 1945 57 221

Aortic occlusion is extremely rare and it is often difficult to say whether it is due to embolism or thrombosis. The author presents 3 cases and calls attention to the postmortem findings.

The first infant died on the eighteenth day of life from uncertain cause. The anatomical diagnosis was focal arteritis of the abdominal aorta (thrombosis of the aorta extending into the celiac artery), thrombosis of the left renal and inferior mesenteric arteries, infarction of the liver and left kidney, patchy hemorrhagic infarction and ulceration of the stomach and descending and pelvic colon, a pirated amniotic fluid with fibrin reaction in the alveoli, diffuse atelectasis, small subarachnoid hemorrhages with localized thrombosis of the related meningeal vessels, balanitis and left subacute otitis media.

The second infant died on the fifth day of life with otitis media and severe diarrhea. The anatomical diagnosis was congenital aneurysm of the ductus arteriosus communicating with the aorta and mortem thrombus in the thoracic aorta, non-specific pharyngitis and laryngitis with ulceration, terminal pneumonia, acute bilateral otitis media and acute non-specific esophagitis.

The third infant died on the ninth day with jaundice and diarrhea. The anatomical diagnosis included thrush and a associated bacterial infection of the upper respiratory tract, a periton bronchopneumonia, bilateral renal venous thrombosis, red and white venous infarcts in both kidneys, organizing melotic thrombus in the pulmonary arteries and terminal thrombosis of the renal arteries and abdominal aorta.

In the first patient the thrombosis was associated with a peculiar arteritis; in the other cases it appeared to be secondary to other lesions.

JAMES F. DOUGHERTY, M.D.

Potter, E. L.: The Effect on Infant Mortality of Vitamin K Administered during Labor. *Am J Obst* 1945 50 215

Evidence has been produced (1) many investigations in which there is no doubt that in the majority of infants the prothrombin time is prolonged during the greater part of the first week of life, beyond that which is normal for the adult; (2) that the administration of vitamin K to the mother prior to delivery with infant after birth will usually prevent the continued prolongation; (3) that after prolonged treatment in the neonate or infant administration of vitamin K will also cause a return to normal.

There is no proof, however, that prolongation of prothrombin time is a direct cause of hemorrhage. Many infants with excessively prolonged prothrombin

bin time show no evidence of hemorrhage while others with relatively little prolongation bleed severely. Since almost all infants show some prolongation of prothrombin time during the first week, all who bleed from any cause would be expected to show some abnormality.

The optimistic prophecies which were made early in the study of vitamin K in regard to the prevention of hemorrhage and the reduction in mortality rates following routine administration of vitamin K do not seem to have materialized. The present study as well as the investigations of Sanford *et al* and Parks and Sweet, indicate that in a carefully studied group of infants anything which can be considered hemorrhagic disease is extremely rare and that the incidence of the hemorrhages which do occur in this age group is not modified by administration of vitamin K to the mother prior to delivery or to the infant after birth.

In the present study which was carried on for a period of almost 4 years 6,560 infants weighing over 1,000 gm. were born during the two years in which vitamin K was given, and 6,630 were born during the next 22 months. The total fetal and infant mortality rate of 29.8 for the first 2 years is higher than that of 25.8 for the last 2 years in spite of the fact that no change of significance occurred in the incidence of primiparity, premature delivery, mode of delivery, or other known factors. The mortality rates for liveborn infants are identical in the two series as are also the numbers of infants who showed evidence of hemorrhage on postmortem examination.

The conclusion was that no decrease in infant or fetal mortality can be expected to result from the routine administration of vitamin K to all women during labor.

EDWARD L. CORNELL, M.D.

MISCELLANEOUS

Baird, D. The Influence of Social and Economic Factors on Stillbirths and Neonatal Deaths. *J. Obst. Gyn. B. & Empire*, 1945 52: 217.

In order to compare stillbirth and neonatal mortality rates in different social classes, the records of 3 groups of Aberdeen cases have been analyzed. Group 1 was a series of 1,419 delivered in a nursing home, belonging to the Registrar General's social classes 1 and 2 and mostly under the care of the family doctor. Group 2 was a series of 8,808 booked hospital cases, under the care of specialists belonging to social classes 3, 4, and 5. Group 3 consisted of 501 cases in private specialist practice. In the 3 groups the stillbirth rates were 25.3, 30.4, and 10.0 per cent respectively and the neonatal mortality rates 13.0, 34.5, and 8.1 per cent.

In Groups 1 and 2 the stillbirth rates in full time and premature infants were the same and in each group the stillbirth rate in premature infants was 20 times that in full time infants. The excess mortality of Group 2 over Group 1 was due to the incidence of prematurity in Group 2 being almost double that in Group 1.

The patients in Groups 1 and 3 were in the same social class and the differences in the stillbirth and neonatal mortality rates were probably due to different standards of obstetric care. In Group 1 the stillbirth rate fell from 47.6 per cent in the years 1933 to 37 to 14.9 per cent in the year 1944. This fall was due mainly to improved obstetrics.

In Group 2 the stillbirth rate was 3 times that in Group 3, although the standard of obstetrics was the same. There was very little scope for reduction in the stillbirth rate in Group 2 except by measures designed to improve the health of the mother.

The problem of the high neonatal mortality in Group 2 is largely one of the prevention of prematurity. Seventy per cent of the deaths in premature infants occurred within 48 hours of birth, most of the infants being too feeble to maintain a separate existence.

The stillbirth rate is relatively high with first pregnancies least in the second and thereafter rises with each pregnancy. The rate rises with age in each parity. In Group 2 primiparas the stillbirth rate in the age group from 25 to 34 was nearly 5 times that in the same age group of Group 1 primiparas.

The reproductive efficiency in Group 2 as measured by the stillbirth rate fell off steadily after the age of 30, whereas in Groups 1 and 3 the fall in efficiency was delayed till the age of 30.

In Group 2 63 per cent of the primiparas were under 25 years of age and in Groups 1 and 3 19 per cent. The stillbirth rate in the latter groups would be very high if the reproductive efficiency in these groups fell off as quickly with age as it does in Group 2.

Over 30 per cent of the stillbirths in full time infants in Group 2 are due to intrauterine death of the fetus from unexplained causes. The cause of the onset of premature labor is unexplained in about 50 per cent of the cases in this group. The most probable explanation in both cases is poor health and nutrition of the mother.

From a national point of view the stillbirth and neonatal mortality rates will be most substantially improved by improvement in the standard of health and nutrition of the mothers in Social Classes 3, 4, and 5 corresponding to Group 2 in this series as they constitute the vast majority.

DANIEL G. MORTON, M.D.

Falk, H. C. and Blinick, G. The Pathogenesis of Postabortal Peritonitis. *Am. J. Obst.*, 1945 50: 168.

In this series of 61 cases of postabortal peritonitis all patients presented an endometritis of varying severity. The infection spread from the endometrium to the peritoneum as a result of direct extension through (1) the tubes, (2) the parametrium, (3) the myometrium, and (4) by a combination of these routes.

Direct extension through the tubes seemed to be the pathway of infection in 40, or 66 per cent, of the cases studied.

Extension of the infection from a parametritis to the peritoneum occurred in 6 or 10 per cent of the patients. In 1 patient the peritonitis was caused by rupture of a broad ligament abscess into the peritoneal cavity.

The infection extended through the myometrium in 4 or 7 per cent of the cases.

In 6 patients endometritis salpingitis parametritis and peritonitis were present. The pathway of infection was not clear.

In 4 patients endometritis abscess of the myometrium, salpingitis and peritonitis occurred. It is probable that in this group the tubes were the chief pathways of extension as the myometrium contained discrete abscesses with no contiguous inflammation of the enveloping peritoneum. The cases are not included in the first group because of the questionable etiology of the peritonitis.

Ovarian abscess was found 17 times, an incidence of 18 per cent. Thrombophlebitis of the uterine or ovarian veins or of both occurred in 10 or 33 per cent of all the patients observed. It was more common in the patients with parametritis or myometritis alone or in combination, than in those with salpingitis alone. Of 40 patients with salpingitis and peritonitis 10 showed phlebitis whereas in the 20 cases with parametritis myometritis and peritonitis 10 showed venous inflammation. In 5 of the 20 patients there was localized thrombophlebitis. In 5 embolic abscesses of the lungs were present. No other sites of embolization were found despite careful study.

In this series the most common pathway of infection to the peritoneum was by direct extension through the tubes. EDWARD L. CHANCELL, M.D.

Thoma, C. and Hagaman, J. B.: The Acceptability and Effectiveness of the Condom As a Contraceptive Method. *Am. J. M. Sc.* 1945, 10: 189.

The authors present the condom as an acceptable and effective means of contraception from a public health point of view. A study was conducted under the auspices of the National Committee of Maternal Health, in Watauga County, North Carolina, a rural area with little education as far as birth-control methods were concerned. Condoms of high quality were used. Mostly white people of the farmer class were used in the author's study.

The need for birth control was discussed with all wives concerned in the study and the use of the condom explained. A total of 658 married couples were included in this study and their experiences were followed from September, 1939 to late in 1943. Contraceptive techniques (including withdrawal) had been used by 45% of all couples and were being used at the time of the interview by 38 per cent. Of the 140 couples practicing contraception, 65 per cent were using condoms, 7 per cent withdrawal, 3 per cent douches with jellies, suppositories, safe period and diaphragm each accounting for 1 per cent or less.

Supplies were accepted and used by 39 per cent of the couples. Of these 73 per cent were still using them after a period of 36 months. The degree of protection offered by means of contraception approximated that reported for the diaphragm and jelly and exceeded that afforded by foam powder and by jelly alone.

The prescription of condoms for the prevention of dangerous or undesirable pregnancies requires little of the physician's time and is well suited to inclusion in public health programs. HARRY FIELDS, M.D.

GENITOURINARY SURGERY

ADRENAL, KIDNEY AND URETER

Dahl Iversen E: The Technique of Suprarenalec-
tomy and the Use of This Operation for the
Genitoadrenal Syndrome in Childhood (Tech-
nique de la surrénaléctomie et surrénaléctomie pour
le syndrome génitoadrénal pendant l'enfance) *Acta
ch scand* 1944 90 210

A sketch is given showing the blood supply of the
suprarenal glands an accurate knowledge of which
is necessary for operation on this organ. The supra-
renal gland is relatively very much larger in the
child up to 3 years of age than in the adult the por-
tion of kidney to suprarenal tissue being 3 to 1
in the child and 30 to 1 in the adult.

The technique of suprarenalectomy is described in
detail. The organ may be approached from in front
or behind. The abdominal incision is preferable in
large tumors but in operations for a hormonal syn-
drome without tumor the author prefers the lumbar
incision. The incision is made along the lower border
of the twelfth rib and this rib is resected. American
authors seem to prefer a vertical incision. The lum-
bar incision and resection of the twelfth rib may be
performed on both sides but the author thinks it
preferable to operate only on one side at a time. He
operated on 2 cases in this way with good results
while in a third case in which operation on both
sides was performed at the same time the patient
died of profuse pulmonary atelectasis and pulmonary
edema. He thinks this result may have been due to
the simultaneous removal of both twelfth ribs which
made ventilation of the lungs difficult.

The patient should be examined carefully before
operation to determine whether there is tumor or
hyperplasia. For 2 days before operation he should
be given a diet poor in potassium and rich in salt.
An abundance of carbohydrate and extract of sup-
rarenal cortex should be given before operation.
Glucose solution and suprarenal extract should be
given after operation also the length of this post-
operative treatment depending on the electrolytes
blood sugar blood urea and blood pressure. A phy-
sician should be in constant attendance on the child
for 4 hours after the operation, and a nurse for 4
days. In bilateral operations the left side should be
operated on first as the chances of finding a tumor on
that side are greater.

Four cases in which the author operated are dis-
cussed. In 2 there was a genitoadrenal syndrome
and in the 2 others a Cushing syndrome although
in 1 of these there was some doubt as to the differ-
entiation between the Cushing syndrome and the
genitoadrenal syndrome. There was recovery except
in the case mentioned. In this case there was a small
basophil adenoma in the anterior part of the gland.
In the other cases there was only hyperplasia. In
cases of bilateral hyperplasia bilateral resection

should be performed. If the hyperplasia is unilateral
the operation should be done only on the affected
side if indeed operation is performed at all in such
cases.

So far the treatment has not shown any great
effect in the cases mentioned except an improvement
in the mental condition of the patients.

ADOREY C. MORGAN M.D.

Smith C. G. W. On Urinary Lithiasis in Child-
hood. A Clinical Study of 71 Cases of Urinary
Calculi in Children. *Acta chir scand* 1944 90
170

This article discusses 71 cases of urinary calculi
in children collected from various hospitals in Copen-
hagen from 1929 to 1943 special emphasis being
placed on prognosis and treatment. Of these
patients 51 were male and 20 female almost three
times as many males as females. This corresponds
pretty closely to the figures of other authors for uri-
nary calculi in children and also to those in adults.
Therefore urinary calculosis in children is not near-
ly so rare especially in Denmark, as it has generally
been assumed to be and as considerable damage may
be done to the urinary tract by these stones it is
advisable to remove them surgically as promptly as
possible no matter what the age of the patient.

The age of the children at the time of diagnosis
was quite uniformly distributed from less than 1
year to 14 years of age. However if a study is made
of the time at which symptoms began it will be seen
that stone formation began at a much earlier age
than clinical experience would indicate. It occurs
to a great extent during infancy and this is the period
at which a study of the factors causing it should be
made. Eleven of these children had developed cal-
culi before they were 1 year old. Two-thirds of the
children (41) apparently had the stones before they
were 5 years of age and 25 before they were 3.
Most of these cases showed stones of the kidney
and ureter although the majority of the reports pre-
viously published showed that most of the stones
were in the bladder and urethra.

In 26 of the cases the stones were passed spon-
taneously and in 12 of these there was no recurrence.
In the others the lithiasis persisted. Among 33 cases
subjected to chemical analysis 31 yielded so-called
primary aseptic stones composed of calcium oxalate
urate, and phosphate while only 2 cases yielded in-
fected stones. Evidently infection is not of great
importance in the causation of urinary stones in
childhood. Anomalies of the urinary tract how-
ever are of great importance. Such anomalies were
found in 58 of these cases. Roentgenograms of sev-
eral cases are given in the original article.

Almost a third of these children had no demon-
strable changes in the urine. Normal urine there-
fore should not necessarily lead to a negative diag-

nesia. When pain occurs in the urinary tract, careful examination should be made by means of urography, pyelography, cystoscopy, and cystography.

In this material 63 operations were performed in 53 patients. Primary nephrectomy was performed in 7 cases, simple lithotomy in 36, and several operations were performed in 9 cases. Even very young children bear these operations well. There was only 1 death following operation in this series and this was in an infected case. If there is infection in the urinary tract, treatment should be followed up until the urine is sterile. Both indications and treatment should be conservative in serious bilateral cases.

Among 43 surgical cases re-examined later 34 showed no recurrence. There was recurrence in 9, or 21 per cent, the percentage of recurrence in infected cases being 29 and in noninfected cases 11.

AUDREY G. MURDOX M.D.

Köhler B. The Prognosis after Nephrectomy; A Clinical Study of Early and Late Results. *Acta ch. sc. d.* 944 9 7

A knowledge of the results of nephrectomy, especially the late ones, is very important in surgical urology, but heretofore a careful study of these results has not been made. This article presents a study of the follow-up examination of the patients upon whom nephrectomy was performed at the Maria Hospital in Stockholm from 1905 to 1934. They were 197 in number. Detailed case histories of some types of cases and tables showing the results of treatment are given, as well as an extensive bibliography on the subject.

The number of nephrectomies performed in Sweden is steadily increasing, because of improved diagnosis and greater confidence in surgical treatment. In 1938 545 nephrectomies were performed, or 1 to every 12,000 of the population.

A detailed discussion is given of what is known of the functional condition of the remaining kidney after operation. In this series of cases kidney tuberculosis and kidney tumor are not considered. The cases operated on were mostly cases of hydronephrosis, infection, and calculus.

There were 49 patients with hydronephrosis. Of these 4 died soon after operation and 1 could not be traced. Of the remaining 44, 17 later showed signs of disease of the urinary tract. Nephrectomy was performed for renal ectopia in 1 case and for rupture of the kidney in another. No secondary nephrectomy was necessary for complications following conservative treatment of ruptured kidney, a fact which argues in favor of conservative treatment of this condition. Nephrectomy was performed in 21 cases for infection not connected with concretions. Two of these patients died, and of the remaining 19 11 later had symptoms of disease of the urinary tract. Nephrectomy was performed on 3 patients with cystic kidney and 3 with a renal cyst. One patient operated on for cystic kidney survived for 21 years. Nephrectomy was performed for renal calculus in

103 cases, among these there were 7 postoperative deaths. Two patients could not be traced. Fifty-eight of the remaining 95 showed signs of disease of the urinary tract on later examination. Nephrectomy was performed on 6 patients with vascular disease. This indication for nephrectomy should be rare. Five patients with disease of the ureters were nephrectomized.

The operative mortality was 13, or 6.7 per cent. The mortality was considerably higher for males than for females, 10.6 per cent and 5.6 per cent, respectively. Some form of urological disease was demonstrable in 96 of the 184 patients who survived the operation; a table is given showing details of the nature of these diseases. Urinary tract infections occurred in 37 per cent of the nephrectomized females and 21 per cent of the males. Of 103 patients now living who were examined by means of non-protein-nitrogen determinations 4 had imminent or manifest uremia. Of the 56 patients tested for creatinine clearance 6 (10 per cent) had reduced renal function. For practical purposes it is sufficient to test the kidney function of nephrectomized patients by non-protein-nitrogen estimations and concentration tests. The risk of uremia was still remote in the majority of the patients with reduced kidney function. Blood pressure determinations on 111 patients showed hypertension in 61, or 55 per cent.

Life expectancy in nephrectomized patients depends on whether pathological symptoms persist in the urinary tract. Deaths from urinary-tract disease were found to be common in the patients who survived operation. It should be possible to decrease this risk by adequate treatment after nephrectomy. Some patients should be kept under continuous supervision after the operation. Even if the patient is clinically well some years after the operation there is still a possibility of complications such as the reformation of stones after nephrectomy for calculus.

AUDREY G. MURDOX M.D.

BLADDER, URETHRA, AND PENIS

Tauber R.: Stricture of the Female Urethra with Lymphopathia Venerea. *A. M. S. J.* 945 1

A colored woman, age forty-one, was admitted to the hospital complaining of great difficulty in voiding her urine. She stated that ten years ago on a very cold day she had to wait for a trolley car a very long time and arriving at the factory she felt cold "up to the navel." She was unable to pass urine, and on her way home she started dribbling. Her family physician could not pass a catheter and ordered medicine which improved the condition temporarily. Since this time the patient had been under medical care.

On physical examination the urethra was found to be extremely narrowed and allowed only the passage of a filiform urethral catheter by which the greatly overdistended bladder was evacuated. The Wassermann reaction was negative.

GENITAL ORGANS

Munger A D The Treatment of Carcinoma of the Prostate by Irradiation *Radiology* 1945 45 31

In his introduction the author emphasizes the high incidence of prostatic carcinoma (from 14 to 20 per cent of all prostatic tumors) and its bad prognosis due to the absence of symptoms which prevents early diagnosis and also due to the early formation of metastases. He gives a clinical classification of this condition (based upon a previous study) which allows a more accurate prognosis. He acknowledges the significance of a rise of the acid phosphatase serum level, the importance of sterilization and the role of hormone treatments but he does not share Huggins' opinion that orchiectomy is the method of choice. He believes that x-ray sterilization combined with regional irradiation is more effective. In order to clarify this point the following series of 27 cases of histologically proved carcinoma of the prostate was treated during a two-year period ending May 1943. (The results refer to the time of presentation of this paper September 1944.) The cases were divided into 3 groups. The first was treated by resection (mainly for biopsy purposes) and by orchiectomy. Of the 7 cases so treated only 2 were successfully stabilized. Two of the patients died of metastases, and 3 had metastases when first seen.

The cases in group 2 were treated by resection and regional and testicular irradiation. Of the 12 cases so treated 10 were successfully stabilized. Two patients died of metastases but 1 of these had discontinued the treatments. Seven had metastases when first seen.

The cases in group 3 were treated by resection, regional irradiation, testicular irradiation and estrogen therapy (ethinyl-estradiol). Of 8 cases so treated 7 were successfully stabilized. The subjective well-being of the patients was superior to that of other groups. One patient died of cerebral hemorrhage.

The acid phosphatase serum level was studied in all of the patients.

The author arrives at the following conclusions:

1. Treatment consisting of resection, testicular irradiation, local irradiation and estrogen administration gives the best results.
2. An elevation of the acid phosphatase level is a reliable indicator of activity but its absence does not prove the contrary.
3. The experience of other authors that x-ray castration was incomplete is explained by their giving an insufficient dose to the testes.

The author gives daily doses of 300 roentgens, i.e. a total of 1800 roentgens in six days to the testicles. He uses 200 kv. (peak) 0.5 mm. of copper plus 1 mm. of aluminum filter H.V.L. 9 mm. of copper. This is followed by a more or less conventional deep x-ray therapy to the pelvis through 4 portals up to a depth dose of 5500 roentgens in the midpelvis in fractionated doses. This constitutes the aforementioned regional irradiation.

The only positive finding in the case was the positive reaction to the Frei test which proved to the author that the patient was suffering from lymphopathia venerea.

Lymphopathia venerea is a disease of the lymph channels and of the nodes which is due to a filtrable virus and gives a positive reaction to the Frei test.

The lymphopathic infection of the urethral mucosa may occur in different forms: erosion, superficial ulcer and seropurulent inflammation.

It should be emphasized that there is a variation in the form of the disease in men and women as a result of differences in the distribution of the lymphatic drainage.

In the male most of the lymph channels of the genitalia drain into the inguinal nodes and some drain into the deeper iliac nodes. In the female on the contrary only the lymph from the clitoris and external vulva drains into the inguinal nodes while the supply from the vaginal mucosa (and especially from the posterior vaginal wall) drains into the lymph nodes around the rectum where there are three lymph plexuses extending together up in the rectum to a height of from 4 to 6 cm. Consequently rectal strictures are much more common in females than in males who suffer from this disease.

The lymphatics of the whole urethra in the female pass to the hypogastric nodes. This is the reason that we do not find enlarged inguinal nodes in case of involvement of the urethra alone. A stricture of the urethra caused by lymphopathic disease can be explained only by a primary involvement of the urethral mucosa and the lymphatics in the immediate neighborhood. In the urethra a primary involvement of the mucosa takes place and the infection spreads through the lymph channels from the urethral mucous membrane and forms scars with stricture formation of the urethra.

The diagnosis of lymphopathia venerea has been greatly simplified by the discovery of Frei, announced late in 1925. This specific cutaneous sensitivity lasts for many years, perhaps during the life of the patient; in other words the patient develops an allergic state.

The fact that a patient is suffering from lymphopathia venerea does not prove that the lymphopathia venerea stands in causal relationship to her urethral stricture. A case of proved lymphopathia venerea may induce urethral stricture following trauma during a delivery and in such a case one the combination of stricture of the urethra and a positive Frei test.

If the stricture is not too tight nor spread over too large an area it may be treated by rapid dilatation putting the patient under gas anesthesia and passing Hegar dilators until the canal is enlarged from 2 to 3 mm. in diameter or up to the size of the average glass catheter from 6 to 7 mm.

The patients should be warned that recurrences are common and that for this reason they should return several times a year for dilatation.

JOHN A. LOFF, M.D.

determination resistance to spermaticides viscosity and rate of liquefaction are made as a rule although none of these factors has as yet been proved of decisive import in matters of fertility. The material is then prepared for microscopic study.

A thin film is made from well-mixed seminal fluid (thorough mixing is essential as immotile sperm sinks rapidly on standing). Dense specimens may be diluted with an equal quantity of Ringer or other isotonic diluent. The sperm is fixed by inverting it over a drop of 2 per cent osmic acid in a watch glass for five minutes. The seminal fluid is then coagulated by flooding the slide with Schaudinn's fluid for one minute. After fixing the slide is rinsed in alcoholic iodine washed in running water for ten minutes, counterstained in 1/2 per cent rose bengal (either the watery or the 70 per cent alcoholic solution for one minute), dehydrated and mounted.

The slides are examined under 1/12th objective, 200 being counted in routine practice. The sperm when counted is classified as (a) normal or abnormal as to the head with subclassifications into (b) amorphous, (c) monster, (d) double, (f) pin, and (g) round pear or tapering or as to the middlepiece and tail, with subclassification into (h) collar (i) bent, (j) thick neck, (k) double tail (l) folded tail and (m) ring forms. These letters correspond to those on Figure 1. The authors studies indicated that in the fertile male the abnormal forms should not comprise more than 35 per cent of the total sperm count.

The total sperm count per cubic centimeter of seminal fluid the motility and the "viability" are determined in seminal fluid warmed in an incubator for one hour to 37 C. The fluid is diluted appropriately and counted on a warmed Thoma slide. One drop is counted for the number of immotile and feebly motile sperm, and another drop, in which the sperm is immobilized by osmic-acid fumes is given a total count, and the difference between these two counts designates the number of fully motile sperm. The authors consider that the total figure, the so-called density should be at least 50 million sperm per cubic centimeter of seminal fluid in a fertile male and the number of fully motile sperm should range from 50 to 10 per cent according to the time elapsed (from one half to seven hours) since the specimen was procured. A similar estimation is made after three hours and after five hours of incubation (the so-called index of viability). Viability is judged by the ratio of the percentage of motility after three and after five hours of incubation in diluting fluid to that after one hour the sum of these two ratios being designated the "viability ratio." If no fall in activity occurs during the five hours the viability ratio would be 2. The authors state that in the fertile male the viability ratio one half hour after the specimen of semen fluid is procured should be 2.5. In one-half to three hours it may drop to 2.25, in three to five hours to 2.0 and in five to seven hours to 1.5. In 236 clinical cases seen by the author at Exeter in South England

examination was carried out as described and in an attempt to establish a means of assessing the fertility the cases were designated an A for each of the four factors just discussed when they were above the minimum figures given for probable fertility and a B when less than that figure indicated a probable subfertility. In the 236 cases there were 31 with a rating of AAAA 63 with AAAB 51 with AABBB and 50 with BBBB.

Applying these criteria and taking into consideration the wife's degree of fertility or subfertility in each case the authors are of the opinion that male subfertility does not become of primary importance unless the results of the semen analysis are found to fall below these minimal values in all four factors (about 20 per cent of all cases). In this 20 per cent, treatment with testosterone propionate, gestyl, synaplofin, methyltestosterone tablets, testosterone implants, ambion A androgens or thyroid did not seem to get any results. The analysis is of relative importance when the values fall below the minimum in at least two of the factors (about another 40 per cent).

For the immense amount of detail concerning the minor factors affecting these general considerations and the authors' recommendations for further work in this field the reader is referred to the original article.

JOHN W. BARRETT, M.D.

McMartin, W. J.: Urological Aspects of Filariasis. *J. Urol. Balt.*, 1945 54 62.

Filariasis has infected thousands in our armed forces stationed in the Pacific area.

The disease in these men is characterized by episodes of lymphangitis and lymphadenitis with the majority of the patients showing genital (scrotal) involvement.

Civilian urologists will be confronted with the problems of differential diagnosis of intrascrotal pathological changes caused by filariasis from intrascrotal pathological changes usually encountered in the United States.

There are many members of our armed forces who have filaria and fear the onset of elephantiasis despite attempts of medical officers to dispel their fears. We can do a great deal to ease these patients' minds by education pertaining to the characteristics of the disease.

There is no specific drug in the treatment of filariasis. Removal of the patient to a temperate climate and away from the chance of more infection is most important.

Rest elevation of the affected parts and cold applications is the treatment of choice in episodes of exacerbations of the disease.

Research on the treatment of filariasis is constantly being carried out by very competent medical personnel. Army and Navy. Excellent results have been reported in the literature soundly based on the knowledge of the pathogenesis of the disease. It is when and if complete postoperative treatment can be done on patients who

have filariasis or who give a history of having had filariasis at some time during their life.

Filariasis will not become a public health problem in the United States.

Permanent disability as a result of filarial infection among our armed forces will be a rarity.

JOHN A. LOFF, M.D.

Hjort E. and Stetvold, K. Postoperative Bacterial Findings in the Lower Urinary Tract after Suprapubic Prostatectomy. *Acta chir scand* 1945 92 115

The two chief dangers in suprapubic prostatectomy are infection and hemorrhage. To combat infection effectively it is necessary to have a thorough knowledge of the types of bacteria most commonly found in the urine. Therefore the authors made daily bacteriological examinations of the urine for two weeks after prostatectomy in 34 cases. They found that the predominant bacteria were the *Escherichia coli* and the *Streptococcus fecalis*, the former being found in 32 cases and the latter in 28. After being demonstrated for the first time these bacteria appeared in every later test. In 2 cases the *Escherichia paracoli* and the *Bacillus alcaligenes fecalis* were found instead of the *Escherichia coli*. The *Bacillus proteus* was found in 5 cases, the *Staphylococcus aureus* was found in 3 cases and the *Pseudomonas* in 1 case.

As the bacteria found in the urinary tract were practically always intestinal bacteria it seems probable that the source of infection lies in the intestine. This infection from the intestine takes place very quickly even when the most careful asepsis is practiced. In 24 cases the urine contained intestinal bacteria on the day after the examination, and all of the specimens of urine were positive for intestinal bacteria on the fifth day. The bacteria are probably carried from the intestine to the bed of the prostate by the blood and lymph. Some experiments made by the authors show that it is improbable that the urethra or the skin are the source of infection.

In 35 cases cultures were made from the enucleated prostate gland; in 12 cases they were positive and in

23 cases negative. They were not positive any more frequently in the cases with prostatitis than in those in which there was only an adenoma. In some cases the prostate gland contained bacteria when there were none in the urine. Examinations of punctate from the exudate in cases of epididymitis showed that this disease is not necessarily caused by the bacteria in the urine but may come from some other source, possibly the urethra.

Two cases of psychosis following prostatectomy are described. They were probably caused by bacterial toxins.

AUDREY G. MORGAN, M.D.

Prince C. L. and Richardson E. J. Jr. AP-43, a New Antispasmodic for Use in Urology. *J. Urol. Balt.* 1945 54 75

A new synthetic antispasmodic, AP-43, was used in a series of 61 cases in which spasm of the smooth muscle of the urinary tract was thought to be the major cause of pain.

This drug was found to be extremely effective in relieving pain resulting from ureter catheterization and retrograde pyelography.

AP-43 will promote the passage of a substantial number of ureteral calculi, when their size is not such as to preclude their spontaneous passage. With this type of calculus AP-43 will relieve pain in the great majority of cases. Apparently, unless pain is present with the calculus, the drug is not effective in assisting the passage of the stone.

In 13 of 10 cases of severe bladder spasms AP-43 gave complete relief.

It is suggested that AP-43 is of value when used under the following circumstances: (1) prior to retrograde pyelography to prevent postpyelogram pain; (2) prior to cystoscopy as an aid to ureter catheterization; (3) prior to cystoscopic manipulation of ureteral calculi to give greater relaxation of the ureter.

Undesired side effects are uncommon and usually mild in nature when they occur. There was no evidence of cumulative toxic effects in this series of cases.

The drug may be given effectively either by mouth or intramuscularly.

JOHN A. LOFF, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Weeden W M and Stein H D : Experiences with Injuries and Diseases of Bone in World War II
1 *n Surg* 945 3

In an evacuation hospital which, by force of circumstances, acted as a general hospital the authors treated numerous cases of injury and disease of practically every bone in the body.

Most fractures of the clavicle responded to simple treatment—a cruciate splint, holding the shoulders back and leaving the arms free. In general this has proved satisfactory. In cases of osteomyelitis, the most rapid closure was obtained by removing the whole involved portion.

Fractures of the scapula require little treatment beyond strapping and rest of the part. Osteomyelitis may be rather extensive and in one case required the removal of the entire body of the bone.

Fractures of the ribs, without pleural or pulmonary damage are also easily cared for. Infection may be extensive, and may spread rapidly.

Fractures of the vertebrae were treated by plaster jackets and rest for a period of four months, although so prolonged a rest may be unnecessary. Transverse-process fractures respond quickly to several weeks of rest in a light plaster jacket, or to merely adhesive strapping.

The hanging cast¹ for fractures of the shaft of the humerus has given excellent results. Immobilization for from six to eight weeks proved sufficient, and early treatment with heat and massage helped to restore full motion.

Fractures of the olecranon process or the epicondyles are best treated by open reduction and accurate replacement of the fractured fragment. Early active motion is necessary. When complete ankylosis is unavoidable, an effort should be made to accomplish it with the arm in about 80° flexion.

Fractures of the shaft of the femur have been treated frequently with a three way splint—a 6-inch wide plaster splint applied posteriorly, extending from the tip of the scapula to the end of the toes, a second similar splint extending laterally from the lower ribs to the tip of the external malleolus, and a third splint applied anteriorly running obliquely from the anterior superior spine to the inner surface of the knee. This type of splint is effective, comfortable, easily adjustable, less likely to cause pressure sores, and can be removed in part for early muscle massage. *SAMUEL KAHY, M.D.*

Weens, H. S., and Brown, C. E.: Atrophy of the Terminal Phalanges in Clubbing and Hypertrophic Osteoarthropathy. *Radiology* 945 45 57

Hypertrophic osteoarthropathy is a condition well known to clinicians and radiologists alike. Its

clinical manifestations, however, differ from its roentgen findings by their location. The physical examination reveals that the soft tissue swelling is most marked around the terminal phalanges of the fingers and toes (clubbing) whereas the roentgenological findings which consist mainly of penosteal new bone apposition, predominantly involve the distal shafts of the ulnae radii tibiae and fibulae, occasionally extend to the proximal phalanges but almost never affect the terminal phalanges.

The authors refer to the small number of previously reported cases which showed atrophic bone changes in the terminal phalanges and add 2 of their own. The first case—that of a fifty nine year-old colored female displayed marked destruction of all the terminal phalanges thinning of the shafts of the middle phalanges of the toes and hypertrophic periostitis of the long bones. There were no signs of pulmonary or heart disease. The second patient, a colored male thirty years of age, was afflicted with congenital heart disease. The only x ray finding in his case was atrophy of the ungual processes of the terminal phalanges of his toes.

The authors conclude that this bone atrophy was preceded by the more commonly known hypertrophic changes mainly because histological and roentgenological examinations by others have shown that lacunar absorption and osteoporosis of the newly formed subperiosteal bone occur in advanced cases. (The explanation that pressure from neighboring soft tissue swelling or from dilated pulsating small blood vessels causes the erosion of the terminal phalanges has not been confirmed by pathologists according to the authors.) In the differential diagnosis of atrophic or destructive changes of the terminal phalanges, Raynaud's disease, scleroderma, psoriasis, syringomyelia, tabes dorsalis and leprosy are discussed. *GERHART S. SCHWAB, M.D.*

Kautz, F. C. Capsular Osteoma of the Knee Joint. *Radiology* 945 45 62

The author presents 4 cases of benign osteoma of the knee joint and concludes that osteoma of the knee joint as well as of other joints such as the elbow hip shoulder and ankle is rare.

Roentgenograms reveal characteristic changes, differing from those in other arthrogenic tumors, such as chondromatosis or joint mice. The absence of any bone connection between the tumor and the adjoining bony structures can readily be demonstrated. The blood vessels and surrounding skeletal parts are never invaded. A well-delimited shadow of bony density with cancellous and sometimes spongy pattern is usually found with small irregular areas of increased radiolucency. There is a more or less continuous dense outer shell and the shape of the shadow may be that of an hourglass, an Indian club, an egg or of the patella.

The history usually ranges over many years and often dates back to traumatism during the age of bone growth with repeated mechanical damage to the knee in the interval. The size of the tumor as shown on roentgenograms and at operation is barely in proportion to the low grade functional impairment and clinical complaints. Symptoms and signs seem to become more marked as the patient enters middle age.

The etiology is still obscure. The authors observations and those of others seem to support the opinion of Kienbock that infection plays no part and that a single injury can hardly be the cause of the condition. Since repeated traumatism of occupational or athletic character can be traced over many years in the majority of the patients it can be assumed that mechanical influences induce a proliferation of a normally dormant biologically polyvalent and potentially bone forming synovial tissue. Whether the primary damage of the synovial cells consists in a constitutional embryonal aberration or a traumatic detachment with subsequent implantation before the termination of bone growth cannot be decided. Insidious proliferation of dormant embryonal-cell rests with metaplastic changes is well known in tumor pathology. A similar origin of the joint osteoma from synovial implantations under the impact of repeated mechanical damage over a long period of time conforms well with the present conception of tumor formation.

DOUGLAS R. MORTON, M.D.

Hartz, P. H.: Cancerous Synovial Tumors. *Arch. Path. Chic.* 1945 40 88

Three cases of a cancerous synovial tumor are presented. In 2 cases the tumor originated in the knee joint and in 1 case in the foot probably from a tendon sheath. In 1 case the tumor cells were uni-laterally differentiated and resembled histiocytes whereas in the other 2 cases the tumor showed a complex organoid structure with cells resembling epithelium. In all 3 cases the patient was treated by amputation. In 2 cases the cancerous nature of the disease was recognized only by microscopic examination.

ROBERT I. MONTGOMERY, M.D.

McLaughlin, H. L.: Lesions of the Musculotendinous Cuff. *J. Am. M. Ass.* 1945 128 563

Sixty proved ruptures of the short rotator cuff of the shoulder form the basis of this report. Eleven of the patients were under forty years of age and 5 were under thirty years of age. Nineteen of the patients were women.

Most of these ruptures occurred in well used shoulders in individuals past middle age. It is reasonably certain that sufficient degeneration at times so weakens the tendon for strains that it may rupture without significant cause.

Early repair is not warranted in the average case because early repair has been no easier to accomplish than late repair. The results of early and late repair have been identical. The symptoms in a large per-

centage of cases showing a clearcut clinical picture of rupture subside spontaneously under conservative therapy to such an extent that repair never need be done. Since rupture almost always takes place through a degenerating portion of the tendon efficient union of the repair can be expected only after the degenerated edges of the tear are excised. Whether operation is done early or late excision of the periphery is equally necessary. It has been demonstrated that the tendons making up the upper segment in any given position of humeral rotation are an essential factor in both initiation and maintenance of abduction and that the function of the individual intrinsic muscles is interchangeable in this respect. Dislocation at the shoulder accompanied by a fracture of the greater tuberosity almost always is accompanied by a torn cuff.

More than 100 calcific deposits of the shoulder have been explored. Only 1 was accompanied by a torn tendon. The only definite indication for exploration consists of pain or disability sufficient in duration or severity to make the procedure worthwhile from the patient's point of view. A plan was followed for the diagnosis and evaluation of the torn shoulder cuff. Sixty-four shoulders with a pre-operative diagnosis of rupture were explored. The diagnosis was incorrect in 4 cases.

RICHARD J. BENNETT, JR., M.D.

Björkroth, T.: Subcutaneous Rupture of the Distal Tendon of the Musculus Biceps Brachii. 2 Cases (Die subkutane Ruptur der distalen Sehne des Musculus bicipitis brachii 2 Fälle). *Acta chir. sc. sc.* 1943 89 30

Two cases of rupture of the distal tendon of the biceps brachii muscle are reported. Both occurred in white males with powerful muscular development. The one a young man of 38 years slipped and fell on the street and in attempting to "break his fall" with his right arm experienced a tearing sensation followed by pain and loss of muscular power in this limb. Later medical examination brought to light the abnormally elevated location of the bulge of the biceps, absence of the taut distal tendon and loss of power in flexion at the elbow and in supination of the forearm. The second man was 58 years old; he had attempted to lift a heavy cask and exhibited practically the same symptoms and findings. In both patients operation was performed 4 and 5 days respectively after the injury.

An incision was made in the bend of the elbow, blunt dissection was carried out down between the muscles, the vessels and nerves being held aside by blunt hooks. The tuberosity of the radius was brought forward and rendered accessible by extreme supination of the forearm; a hole was drilled through it near its base and a linen thread which had previously been attached to the ruptured tendon end was passed through this drill hole which pulled the tendon stump down to the tuberosity where it was secured. For the next four weeks the arm was held at an angle of 90 degrees and in maximal supination.

in a plaster cast. The result was perfect return of muscular function and power.

At microscopic examination a bit of each tendon revealed noticeable degenerative and regressive changes with a suggestion of inflammatory response in the older patient. However the author leaves open the question as to whether the changes were due to the injury itself or to a preceding condition, such as brachioradial bursitis.

JOHN W. BRENNAN, M.D.

Howorth, M. B.: *Echinococcosis of Bone. J. B. N. Surg.* 945: 37-401.

The author presents a case report of echinococcosis of bone with several accompanying roentgenograms (Figs. 1 and 2).

There are numerous cases of echinococcus disease of bone in the world literature (an estimated 1,000) but the disease is rare in the United States.

Bone involvement occurs in about 1 per cent of cases of the disease. Pain is the most common symptom of bone involvement, and is due to leakage or to pathological fracture.

Aspiration or puncture of the cyst yields the characteristic fluid and often scolices or fragments of laminated membrane but it should not be practiced because of the dangers of sensitizing the patient, of anaphylaxis if he is already sensitive, or of producing secondary cysts by implantation of the scolices which escape into the tissues. The fluid is clear and limpid or milky unless stained by other fluids. The scolices are white granules just visible to the eye.

Daughter cysts are milky white opalescent semi-transparent with yellow scolices hooklets or fragments of laminated membrane may be found in the putum urine 1 week after rupture of a cyst. Other laboratory diagnostic tests are discussed.

The differential diagnosis depends largely upon the possibility of echinococcus disease upon laboratory tests and upon the roentgenographic appearance. A negative Mantoux reaction will rule out tuberculosis. Calcium, phosphorus and phosphate determinations may help in distinguishing osteitis fibrosa cystica or Paget's disease. The white blood count, the erythrocyte sedimentation rate and the temperature distinguish osteomyelitis (except cysts with secondary infection). The slow silent course is indicative of echinococcosis rather than of malignancy.

Treatment has been unsatisfactory to date. Marsupialization or sterilization of the cyst may sometimes be successful. Roentgen irradiation has failed. Removal of the entire diseased area has removed the disease, but it is mutilating. Insertion of bone chips will not be successful unless the disease has been eradicated. Amputation is the choice of treatment in selected cases. ROW ET P. MORTON, M.D.

Jones, G. B.: *The Pathology of the Ruptured Plantaris Muscle. B. B. M. J.* 945: 1-876.

The case of a soldier thirty-one years of age who was thrown from a motorcycle is reported. He felt intense pain in the left calf and thought he had been struck a direct blow on the leg but examination



Figs. 1 and 2. Roentgenograms of the right knee show a large polycystic lesion of the lateral femoral condyle with sharp margins, and smaller cysts above the intercondylar notch, erosion posterior to the notch and possibly at the distal lateral margin of the lateral condyle, and moderate dense swelling of the capsule. No productive or periosteal reaction is apparent.

showed that he had slid across the road and had been brought to a stop when the sole of his foot struck the curb which had caused forced dorsiflexion of the ankle. There was an incised wound of the Achilles tendon 3 inches above the ankle joint. The plantaris tendon lay slack in this wound and traction on it delivered the tendon and about half of the muscle belly which had been ruptured transversely at about the middle.

This case and experimental work show that this is the usual mechanism of ruptures of the plantaris. They are not caused by direct violence but by forcible dorsiflexion of the ankle. Because the muscle belly is very short and the tendon very long the length of the belly being only about one-fifth the total length of the muscle and tendon the belly is subjected to much greater tension than the other calf muscles and ruptures much more easily.

AUDREY G. MORGAN M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS ETC.

Du Tolt G. T., and Enslin T. B.: Analysis of 100 Consecutive Arthrotomies for Traumatic Internal Derangement of the Knee Joint. *J. Bone Surg.* 1945 37 412

An analysis has been made of 100 consecutive knee arthrotomies performed on European miners working underground in the Witwatersrand Gold Mines.

The routine of clinical diagnosis operation and postoperative care is described.

The operative findings have been analyzed. In 4 cases no meniscal lesions were discovered at operation. In 82 cases tears of the medial meniscus were found and in 9 cases tears of the lateral meniscus were seen. There were double tears in 5 cases and discoid menisci in 2. Of 97 torn menisci 49 were of the bucket handle type.

The operative findings have been correlated with the signs found at examination.

Pain at the anteromedial joint line was found to be of considerable diagnostic significance. Absence of such pain contraindicated arthrotomy for a meniscal lesion.

It was shown that locking is frequently, but not always due to a meniscal lesion. A stub of anterior cruciate ligament was the cause of locking in 1 case.

Meniscal damage may exist in the absence of wasting.

Fouche's hot spot on the medial facet of the patella is described.

The crushing sign is found to be not entirely pathognomonic of meniscal damage.

Erroneous diagnoses and operative complications have been analyzed in some detail.

The end results of treatment are given. The disability assessments averaged 1.6 per cent for the whole series.

The penalty of delay in operation has been found to vary greatly according to the type of lesion.

The findings in the authors' investigation favor early and total meniscectomy if an incontrovertible diagnosis has been made.

From the medicolegal point of view it should be accepted that a very minor trauma may produce a torn meniscus. Although clinical manifestations following trauma may be delayed for months lack of pain does not exclude the possibility of a tear.

The postoperative routine is reported as follows.

The foot of the bed was raised on 8-inch blocks. On the second day active foot and ankle movements were started and on the third day, active quadriceps contractions were begun. Straight leg raising ten times per hour was initiated on the fourth day and active flexion to the extent permitted by the dressing was allowed on the seventh day. On the twelfth day the stitches were removed and the patient was seated in a wheel chair. Thus the knee was unconsciously flexed to 90 degrees. The quadriceps drill was maintained. The patient was usually able to lift his knee 200 times at one sitting on the fourteenth day and beginning at this time he was allowed to attempt walking with the aid of a cane. On the sixteenth or seventeenth postoperative day the patient was formally discharged but he continued in daily attendance in the outpatient department traveling by bus or tram to the hospital. From the fourth week, the patient was instructed to swim ride a bicycle do antigravity weight and pulley exercises or stationary rowboat exercises and to walk several miles daily. Work was usually resumed at the end of the sixth or the seventh week.

ROBERT P. MONTGOMERY M.D.

FRACTURES AND DISLOCATIONS

Tordoir, B. M. and Moeya, E. J.: Medullary Nail for Fractures. *J. Am. Med. Ass.* 1945 138 792

The use of a V2A steel nail was introduced in 1940 by Kuentscher. In 1944 Boehler published his book which gave the results with the use of the V2A nail in 500 cases. The type of fracture which responds best to this method of treatment is the transverse fracture of the diaphysis as the nail is fixed in both epiphyseal ends without injuring the articular cartilages. A few days after this operation the patient is able to walk about and leave the hospital. This method gives an exact reduction of a transverse fracture. The nail may be used in compound fractures if they are treated within a period of 10 hours. It has also been used in the treatment of pseudarthroses.

Before the operation an x-ray examination should be made of the length of the bone and the width of the medullary cavity. Reduction is carried out on a special frame under fluoroscopic control. In the femur an opening is made in the trochanteric fossa with a piercer and a thin stiff nail is pushed through the medullary cavity and beyond the fracture line into the distal fragment. The Kuentscher nail is slipped over the thin wire, and the wire is then removed. For fractures of the tibia a weak spot just

In the second group a perfect cure was obtained in 12 of 13 cases. Only 1 patient had a considerable varus position of the broken elbow. In 3 cases the reduction was poor and yet the function was excellent.

In the third group 12 out of 22 patients treated in a conservative manner had perfect function while 18 underwent an operation and only 3 of these had impaired function. In 1 case the operative reduction failed and yet the functional result was excellent.

The author highly recommends roentgenograms taken in anteroposterior direction with the elbow flexed because only this method furnishes information as to the rotation of the peripheral fragment in relation to the humerus.

As a rule periosteum remains attached to the short distal fragment but the sharp end of the long proximal fragment becomes denuded. The author is of the opinion that the absence of periosteum is responsible for the gradual disappearance of this sharp end. No limitation of flexion was observed in patients in whom, due to an unsuccessful reduction the proximal fragment remained located entirely in front of the distal fragment.

Patients with the elbow in a varus position had no complaints as to function and were occasionally operated on solely for cosmetic reasons. Cubitus varus may follow immobilization of the fracture in supination.

The author is opposed to the use of slings or plaster of Paris splints in cases in which the fragments have lost contact with one another.

A valgus position or ischemia was not found in the author's material. JOSEPH K. NICHOL, M.D.

Westerborn, A. Nailing in the Marrow Cavity in Cases of Recent Fracture and Pseudarthrosis. Report of 28 Cases. *Acta chir scand* 944, 90-89.

In 1940 Kuntscher reported his method of treating fractures by inserting a nail into the marrow cavity. At first it was severely criticized but later quite widely adopted in Germany. The 18 cases reported by Westerborn, 14 of recent fracture and 4 of pseudarthrosis are the first cases published from the Scandinavian countries.

The principle of the method is to fix the fragments after reduction by inserting a nail into the marrow cavity. As the nail is driven in from an incision at a distance from the fracture open reduction is not necessary. It is not a large round nail that fills the marrow cavity but a U or Y-shaped nail that acts in about the same way as the 3 flanged nails used in fractures of the neck of the femur. It touches the endosteum only at three small points and therefore does not injure it or the marrow but produces very firm fixation. An illustration of the nail in place is given in the original article.

This method can be used in all transverse, oblique, and spiral fractures of the long bones especially of the femur. For the femur the nail is inserted from the upper surface of the trochanter either through

the skin or through a small incision. In the other long bones a small hole must be bored in the cortex at a distance from the fracture. Kuntscher advocates bloodless reduction but this is not always possible. The insertion of the nail must be made under fluoroscopic observation or checked by several roentgenograms. A number of typical cases are described and illustrated with the roentgenograms.

As it is unnecessary to expose the fracture in this method there is little danger of infection. If infection occurs it results in localized osteitis, never in diffuse osteomyelitis. There is little risk of fat embolism. Only 2 deaths from this cause have been reported in the literature. Bone healing occurred promptly in all of the author's cases of recent fracture.

He had good results in the cases of pseudarthrosis also. The method ensures absolute stability and permits of early weight bearing, two conditions necessary for healing. The ends of the bones should be freshened and any tissue between them removed. Six of the cases of pseudarthrosis were in war veterans and involved the femur; they had persisted for from 1/2 to 3 years and resisted other methods of treatment. Bone healing took place in all 6 cases. Osseous healing occurred within 3 months in 3 cases of pseudarthrosis of the humerus. Four cases have been operated upon so recently that the final results cannot be judged. AUGUST G. MORGAN, M.D.

Sandegard, E. Fracture of the Lower End of the Humerus in Children—Treatment and End-Results. *Acta chir scand* 943, 89.

At the Children's Hospital in Göteborg, Sweden where the author is Surgeon-in-Chief, the treatment of fractures of the elbow has been different from that usually described in the literature. He discusses 157 cases of fracture of the lower end of the humerus seen from 1909 to 1940. These included 164 cases of supracondylar fracture, 46 of medial epicondylar fracture, 40 of lateral condylar fracture, 4 of medial condylar fracture, 3 of transcondylar fracture but none of epicondylar fracture. The latter are extremely rare while comminuted fractures and T and Y-shaped fractures are practically never seen in children as they usually occur only when there is a certain degree of bone fragility.

Of these patients 189 were re-examined later. Most of them had been treated surgically. Fixation as a rule had been carried out with Risser's stainless steel nails which proved very effective. These were always extracted within three weeks. Catgut is not strong enough for operations on bone.

Two-thirds of the cases of supracondylar fracture were treated surgically. The forearm had to be immobilized in semipronation after operation because of the risk of allying of the fragments. The functional results were very good but a considerable number of cases showed cubitus varus and a few cubitus valgus.

Great emphasis is placed on the necessity for accuracy in reduction. Faulty reduction is the

cause of practically all the pathological changes that take place at the angle of the elbow after operation. Accurate reduction is sometimes quite difficult in these cases. And a excellent results are sometimes obtained by conservative treatment; operation can not be recommended unconditionally except in very stubborn cases.

Over 60 per cent of the cases of lateral condylar fracture were treated surgically. The results were very good and extirpation of the fragment was not found necessary in any of them. As there is a risk of pseudarthrosis in these cases with conservative treatment, operative reduction and fixation is recommended.

Because of the necessity for exact reduction in intra-articular fractures, extraction of the fragment is necessary in most cases of medial condylar fracture and transcondylar fracture. Good results are obtained with this method.

Generally it is not necessary to extract the fragment in medial epicondylar fractures. Immediate repair of the torn capsule and ligaments is possible by a very simple operative technique and good results are obtained.

Röntgenograms of a number of illustrative cases are given in the original article and a useful method of interpreting roentgenograms is discussed.

AUDREY G. MORGAN, M.D.

McKeever, F. M.: Fracture of the Femur in Adults. *J. Am. M. Ass.* 1945 128 1006

McKeever reports his observations on 47 patients suffering from closed fractures of the shaft of the femur in a military group between the ages of eighteen and forty. While the author did not initiate the treatment instituted, all patients were eventually placed under his care. Twenty three patients were treated by suspension and skeletal traction (Kirchner wire or a variation of the Steinmann pin). Open reduction was done in 17 cases—in 7 of these it was used after other methods failed (in the surgeon's opinion) to produce satisfactory position.

Seven patients were treated by external skeletal fixation with the use of some mechanical device. All patients were followed up from six and one half to twenty four months. The average period of time elapsing between the injury and the date of evaluation was twelve months. The average period of recumbency for patients treated by internal fixation was one hundred and eighty five days; by external fixation one hundred and sixty-eight days; and by traction one hundred and forty five days. The period of protection is the time between the injury and that when the patient is able to bear full weight without braces or crutches. The average time of total protection in the group treated by traction was two hundred and nineteen days, of those treated by plating two hundred and sixty six days and of those treated by external skeletal fixation three hundred and seventy days.

The roentgen evidence of bony union appeared in an average of two hundred and thirty three days in

23 femurs treated by traction. In 1 patient treated by internal fixation it was three hundred and three days and in 7 patients treated by external skeletal fixation it was three hundred and sixty four days. The criteria for bony union are obliteration of the fracture line and re-establishment of the bony trabeculae. No patient treated by traction had any loss of motion in the hip, ankle or foot. The average arc of flexion of the knee in 23 patients treated by traction was 101 degrees. In 17 cases treated by internal fixation the average arc was 85 degrees and following external fixation it was 78 degrees.

There was no loss of length in patients treated by external skeletal fixation but 3 patients, or 17 per cent, who were treated by internal fixation and 5 patients or 21 per cent who were treated by traction showed varying amounts of shortening. In 1 patient this shortening was sufficient to produce disability.

The results of treatment as judged by disability resulting from shortening of the extremity from loss of motion in the knee and other joints, and from the degree of muscular atrophy in this group showed that both external fixation and internal fixation were definitely inferior to traction.

Complications were most frequent in the group treated by open reduction and internal fixation. The complications included osteomyelitis, postoperative infection, thrombophlebitis, nonunion, broken and bent plates and palsy of the peroneal nerve. By percentages, 13 per cent of the complications occurred in patients treated by traction, 53 per cent in those treated by internal fixation and 57 per cent in those treated by external fixation.

From these studies McKeever points out that the safest method of treatment for fracture of the femur for the average surgeon in the average hospital is traction, and that open reduction should be reserved for those cases in which there is definite evidence of soft tissue interposition. The general use of apparatus designed for external fixation and ambulation is likely to delay union and carries the great risk of producing osteomyelitis at the sites of the fixation pins.

BENJAMIN GOLDMAN, M.D.

Moberg, E.: On the Operative Therapy and Prognosis in Fracture of the Patella. *Acta chir. scand.* 1944 90 295

From 1918 to 1923 104 cases of fracture of the patella due to accidents at work were reported to the National Insurance Office. Forty four of them were treated surgically. Only those subjected to operation are considered in this attempt to determine the results of treatment. These fractures require a long time to heal and there is considerable danger of permanent disability. The average time from the date of the accident until the resumption of full time work or settlement by the granting of compensation was 164 days. The average annuity granted the injured workmen was 21 per cent.

A clinical study was also made of the 21 surviving patients representing the operative material (23

Officers messes are generally entered for by contractors and therefore supervision of the kitchens is seldom effective. When an officers' mess is staffed by Army personnel the cook is an Indian, and although he may have been instructed in kitchen hygiene in the absence of proper supervision he will revert to unhygienic methods. Of course, all messes are subject to inspection, which in the case of officers' messes under war conditions, is irregular and often perfunctory. Foodstuffs for officers' messes are often purchased from local bazaars, and uncooked or cold food is frequently eaten. Unlike conditions in the other ranks where each man uses his own mess tin and other eating utensils communal eating utensils are used in the officers' messes, and these are seldom hygienically clean because boiling water is lacking for washing up purposes.

When travelling officers use the restaurants on trains and in stations extensively since they seldom carry rations and do not have the use of the station canteens. In off-duty hours also the officer is subjected to greater risk in that he eats away from his mess to a greater extent than other ranks. Hotels and clubs are mainly or exclusively used by him and the officer class on leave tends to eat more cold or uncooked dishes than other ranks during like periods.

An instance is cited of a hotel in South India much used by officers in transit. The kitchen of this hotel (unscreened) faced on an alley immediately contiguous to two open latrines of the Indian type.

Within a few days in the fall of 1944 7 cases of poliomyelitis developed here, 1 of which was apparently transmitted exclusively by fomites. Shortly before this outbreak 32 young officers arrived on leave at the hotel. Two of them had contracted poliomyelitis after suffering from diarrhea for several days. At a later date 24 of the remainder answered a questionnaire regarding their health during their stay in the hotel. All were fit on arrival, but after three or four days 3 of them felt ill with headache, 4 had diarrhea and a sore throat, and 2 had in addition, fever and pain in one leg. The symptoms were severe enough to confine them to bed for two or three days.

Although the author does not minimize the possibility of case-to-case transmission in the acute stage of poliomyelitis and the transmission by fomites he thinks it is important to consider food and eating utensils in the spread of the disease and recommends the following measures:

1. An improved standard of hygiene in all messes, elimination of contractors from messes, employment of British cooks whenever possible, and improved washing-up facilities.

2. A further warning to British troops of the risk which they run by the consumption of certain articles of uncooked food during the dry season.

3. The introduction of modern methods of kitchen hygiene in all civilian-controlled establishments, including railway restaurants, and a closer supervision of the Army kitchens by the medical officers.

JOHN W. BURNETT, M.D.

SURGERY OF THE BLOOD AND LYMPH SYSTEMS

BLOOD VESSELS

Fariñas, P. L.: Retrograde Arteriography in the Study of the Abdominal Aorta and Iliac Arteries. *Surgery* 1945 18 344.

The author's original technique of retrograde arteriography whereby a rubber catheter is passed from the iliac artery to the desired level in the aorta was described in the 46th volume of the *American Journal of Roentgenology*. At present in view of the difficulties in obtaining rubber catheters he has been compelled to change his technique to the present retrograde abdominal aortography. With this technique the patient is given a barbiturate the night before the operation, and morphine hypodermically one hour before the injection whereupon the femoral artery is exposed by blunt dissection, under local anesthesia at the level of Scarpa's triangle, and punctured with a trocar 1.5 mm. in diameter. Through this trocar is now injected directly and in from 2½ to 3 seconds, 50 c.c. of a 70 per cent solution of diodrast after tourniquets have been placed at the roots of both lower extremities. In certain cases the Trendelenburg posture may be necessary. With a trocar 1.5 mm. in diameter and a constant pressure of 15 pounds which the author secures by a specially designed apparatus 25 c.c. of the shadow mixture are injected per second but the speed of injection is modified to suit the individual patient when necessary. The first plate is taken when 40 c.c. of the opaque substance have been injected, and a second immediately afterward, by means of a fast plate changer. When the injection is finished, the trocar is withdrawn, a stitch placed in the adventitia of the artery at the site of the puncture, and the wound closed.

In the study of the aorta and iliac arteries the most frequent lesion encountered has been atheroma, the characteristic picture of which was elongation and dilatation of the vessels and stenosis caused by lesions of the intima and by secondary calcification. Atheroma is usually found in old age and the lesions are generally seen all along the vessels, being more prominent in the aortic cone and in the iliac arteries.

In addition to the great accuracy with which this method of arteriography permits evaluation of changes in the arterial contour the presence of aneurysms and their degree of canalization it also depicts. In cases of complete obstruction of the aortic cone the characteristics of the consequent collateral circulation. According to the author this consists of anastomoses between the internal mammary and the epigastric arteries, and between the circumflex iliac and the lumbar arteries.

No accidents have been experienced with this method even in patients in very poor physical condition with advanced arterial lesions.

Pathological changes in the visceral branches of the abdominal aorta will be presented in another article.

JOHN W. BRIDGMAN, M.D.

Heifetz, C. J.: Traumatic Aneurysm of the First Portion of the Left Vertebral Artery. *Ann. Surg.* 1945 122 102.

A case report of a traumatic aneurysm of the left extracranial vertebral artery in which a complete cure resulted from an autogenous muscle transplant placed directly into the sac is presented with mention of the available literature on this subject.

Nearly all aneurysms of extracranial vertebral arteries result from traumatism, either gunfire or stabbing. The artery arises as the first branch of the ascending portion of the subclavian artery and ascends obliquely along the lateral margin of the longus coli to enter the foramen of the sixth cervical transverse process. The extraspinal portion is about 1½ inches long and lies beneath the thyrocervical trunk, carotid artery and internal jugular vein and the omohyoid and sternocleidomastoid muscle. Injuries to the vessel in the portion passing through the transverse processes are the most frequent.

The preoperative diagnosis is most difficult to make, frequent ligations of the common carotid artery having been performed by mistake. A pulsatile swelling in the posterolateral part of the neck following trauma is the usual history. Dissection is often difficult but arteriography by injecting into the sac may establish the origin of the swelling. No one surgeon has had sufficient experience to design a dependable approach for surgery. The singular course of the artery and its spacious anastomosis to the analogous vessels of the opposite side, and the connections with other branches and the circle of Willis, account for the inadequacy of proximal and distal ligation alone as treatment, and the difficulty of extirpation. Extirpation is at best hazardous and arduous. The method of incision and tamponade with gauze impregnated with astringents or antiseptics and the use of muscle transplants have been most often resorted to and have been most successful. With the latter method recanalization is said not to occur. Proliferative endarteritis obliterates the aneurysm. A variety of less radical procedures have been tried including injection, irritants and sclerosing media, electropuncture, and electrolysis. Endoneurysmorrhaphy was employed only in Spath's case.

This case report represents 1 of 15 on aneurysm of the extraspinal portion of the vertebral artery; a cure was obtained.

A twenty-seven year-old negro female appeared shortly after being stabbed in the neck over the sternocleidomastoid muscle. The instrument was a thin bladed pocket knife. Her blood pressure was 120/80 pulse 88 and temperature 98.6. Two at

tempts to control bleeding from an unlocated bleeding point were made, followed by packing (open) and a pressure dressing. Two days later it was possible to close the wound by suture. The patient was discharged on the third day to be readmitted on the eleventh because of a pulsating mass, steadily increasing in size since five days after she left the hospital. She was aware of a roaring in the ear and pounding in the neck, which kept her awake at night. The laceration was well healed. Loud systolic and diastolic bruits were heard and a loud systolic apical murmur was also heard. It was thought that the lesion was an arteriovenous aneurysm between the left common carotid artery and the internal jugular vein, or a sacular aneurysm of the common carotid artery. The laboratory studies contributed nothing.

The first attempt to isolate the sac and its tributaries was given up after two-and-one-half hours because of dense fibrous adhesions and the large size and extent of the lesion. The postoperative course was uneventful except that the aneurysm grew in size and the symptoms increased. The second operation was performed through a more extensive incision, including the old one in it. Accidental opening of the sac was controlled by insertion of the index finger which also made it possible to find that the aneurysm originated medially and posteriorly against the vertebral column. Ligation of the vertebral artery at the subclavian, which was also ligated proximal to this branch was done by extending the incision and removing part of the clavicle and sternum. Distal ligation was prevented by hemorrhage, therefore tamponade with live muscle transplants was done and the wound in the vessel was closed. The pulse and blood pressure was maintained by means of blood and fluids given during the procedure which required four hours and forty minutes. Convalescence was relatively uneventful, the aneurysm decreased in size and the only complaint was slight weakness and an ache in the arm.

JAY P. BARTLETT, M.D.

Bauer G.: Thrombosis following Leg Injuries. *Acta chir scand.*, 1944 90 9

A study of thrombosis at the Mariestad Hospital, Mariestad, Sweden shows that a little over a fourth of the cases of thrombosis occur following injuries to the leg. It may occur in as high as 32 per cent of patients who have suffered injuries of the legs. This frequency of thrombosis in leg injuries is doubtless partly due to the prolonged rest in bed but the author believes that the chief etiological factor is the retardation of the blood flow in the popliteal vein caused by swelling of the soft tissues around the knee which results in pressure on the popliteal vein. This theory is supported by the fact that the thrombosis practically always occurs in the injured leg.

Diagnosis in these cases is difficult as the symptoms of thrombosis may be confused with those caused by the original injury. Doubtless before the introduction of venography many cases were not

diagnosed and the whole series of post thrombotic sequelae such as swelling, induration, and leg ulcers occurred in cases in which they might have been prevented. In addition a patient with undiagnosed thrombosis may die suddenly from pulmonary embolism. Therefore, it is very important to make a diagnosis of beginning thrombosis, and the author believes it is justifiable if thrombosis is suspected, to cut the plaster bandage in order to make a thorough clinical and venographic examination. The risks from this procedure are much fewer than those from an undiagnosed and untreated thrombosis.

The best treatment for post traumatic thrombosis is preventive and consists of raising the foot of the bed and having the patient make alternate stretching and relaxing movements of the muscles of the leg, which he can do even with the leg in a cast. Bandages should not be allowed to constrict the region around the knee. Of the specific agents available for the treatment of thrombosis, heparin seems to be the best. As a rule heparin treatment is given for 5 or 6 days—3 doses of 150 mgm. each are given the first day then for a few days morning and evening doses of 100 mgm. and a midday dose of 100 mgm. are given. When temperature becomes normal the dose is reduced to two injections of 100 mgm. each and on the last day only one injection of 100 mgm. is given. However these patients can often not get up at the end of the heparin treatment on account of traction apparatus or casts therefore the heparin treatment may be continued with small doses to prevent recurrence of the thrombosis.

Thirty-three cases of post traumatic thrombosis have been treated with heparin at the Mariestad Hospital in the past 3 years. Only 1 patient died, a woman of 70 who had pulmonary embolism before the heparin had had time to take effect. In all of the other cases the disease did not spread beyond the area involved at the time treatment was begun. The use of heparin has reduced the death rate from pulmonary embolism at this hospital from 5 and 30 per cent to 3 per cent, and the probability of post-thrombotic after-effects has been practically abolished.

ANDREY G. MOROSAN, M.D.

Borgstrom, S.: Prothrombin Index after Operation. *Acta chir scand.* 1943 89 68.

Heretofore studies of the effect of operation on blood prothrombin have been chiefly in cases of obstructive jaundice, and it has been shown that there is a considerable decrease of prothrombin (sometimes amounting to as much as from 30 to 40 per cent) in these cases.

The author studied the effect of operation on the blood prothrombin level in 101 patients without icterus using Lehmann's micromodification of Quick's method of determining prothrombin. The cases were ones of chronic disease and the patients had been kept in the hospital for some time before operation, so that they were on the same diet and had had uniform treatment. Patients who had been given vitamin K or blood transfusions were ex-

clouded, as it has been shown that blood transfusion affects the prothrombin level for from 6 to 12 hours. No decrease in the prothrombin level was found on the day after operation and the amount of blood lost during operation did not make any difference. It has been claimed that a decrease of prothrombin is caused by the loss of blood. The loss of half a liter of blood by means of phlebotomy had no perceptible effect on the prothrombin index.

The anesthetics used by the author in these cases seemed to have a certain effect on the prothrombin level. There was no decrease after operations in which local or lumbar anesthesia was used but there was a small but definite decrease after operations under nitrous oxide and ether. The maximum decrease was on the fourth day after operation.

AUDREY G. MORGAN M.D.

BLOOD TRANSFUSION

Plaut, G., Barrow M. L. and Abbott, J. M. Results of Routine Investigation for the Rh Factor *Brit M J.*, 1945 2 273.

From routine examinations of blood information has been accumulated on the incidence and importance of the Rh factor. In the first series (3,944 cases), 84 per cent were Rh positive and 16 per cent were Rh negative. In a second series (2,473 cases) in which further subdivisions of the Rh factor were made, 83.3 per cent were Rh-positive, 14.9 per cent were Rh-negative, 1 per cent were Rh- and 0.7 per cent were Rh.

Of 136 women with infants presenting either a history or serological findings suggesting hemolytic anemia, 120 (88.2 per cent) were Rh-negative. The red cells of 55 affected babies with Rh negative mothers were available for examination in 53 they were Rh positive and in 2 they belonged to the sub-group Rh-negative. Anti-Rh agglutinins were found in the serum of 94 (79.6%) of the 120 Rh negative women. In the remainder no anti-Rh agglutinins could be found even though tests were made under varying circumstances during and after pregnancy.

The first pregnancy of 80 of the 120 Rh-negative mothers ended with a child normal at birth and during infancy. In 27 cases the child was suffering from hemolytic disease or was still-born in 5 the pregnancy ended in a miscarriage and in 8 the child died from unknown causes or from causes other than hemolytic disease of the newborn. Of the 80 normal first children, 33 were Rh-positive, 5 were Rh negative and 42 were not tested.

Reactions were reported in 48 patients after the transfusion of blood of the compatible ABO type. 18 occurred in Rh-positive patients and 30 in Rh-negative patients. Of the 30 Rh negative patients included, 2 had previous transfusions with known Rh-positive blood without any reactions. The transfusion of Rh-negative individuals with Rh-positive blood is a not uncommon cause of relatively mild reactions and may result in more severe reactions.

LUCIAN J. FROMMELT M.D.

Volkert, M. and Piper, J.: Heparin Content of the Blood in Clinical Thrombosis. *Acta chir scand.*, 1943 89 417.

Experiments on rabbits have shown that certain operations on the veins might produce an increase in the heparin content of the blood. In the authors' experience, however, this did not occur unless factors which cause coagulation, such as sutures of thick silk through one or more of the veins, were used during the operation.

It was therefore believed worth while to make a clinical study to determine whether such increase in heparin content could be brought about by operation in man. The heparin content was measured by determination of the antithrombin content of the blood.

Details concerning the results obtained in 33 cases are shown in a series of tables. From these it is evident that the heparin content of the blood in man increases only in very serious and dangerous thrombotic conditions such as for example relapsing infarction of the lungs in which after a certain latent period, there was an increase of the heparin content to double its normal amount.

It would seem, therefore, that an increase in heparin content of the blood has a certain value in prognosis but the available material is insufficient to permit of final conclusions on this subject. Since the human body apparently tries in certain cases to counteract dangerous thrombosis by increased production of heparin, it is possible that heparin medication may be indicated to support this defensive action.

AUDREY G. MORGAN M.D.

Reich, C., Yahr M.D., Eggers, C. and Lipkin R.: Dicumarol in the Prevention of Postoperative Thrombosis and Pulmonary Embolism. *Surg* 1945 18 238.

During the period from October 1943 to July 1944, in an effort to further evaluate the use of dicumarol, the authors subjected a series of surgical patients (103 cases) to a prophylactic course of the drug with the thought of preventing postoperative thrombosis and pulmonary embolism. During this same period the drug was used in the treatment of cases of venous thrombosis (33 cases) and pulmonary embolism (9 cases) which arose in the surgical services.

Since the statistics show that this condition does not begin until approximately the sixth or seventh postoperative day, it was believed best to start the drug on the third to the fourth postoperative day. In this way the prothrombin time was not prolonged at the time of operation and a few days were permitted to elapse postoperatively in order that healing might begin. That this time, namely the third or fourth postoperative day, was the most opportune day to administer the drug was shown by the fact that neither thrombotic phenomena nor postoperative bleeding were found.

Before administration is started, a prothrombin determination is done to find the patient's normal blood level. After this has been established, 300

mgm. of dicumarol are given then on the following day a prothrombin level is done again and unless it is markedly prolonged 100 mgm. of the drug are given at this time. The object is to prolong the prothrombin time to twice its normal value. In other words if the normal time is from 17 to 20 seconds the therapeutic range would be about 34 to 40 seconds. Subsequent doses must be adjusted individually. In many cases the prothrombin time is prolonged rapidly and prothrombin determination on the third day shows that the patient is already in the therapeutic range, then it is best not to give any drug on that day and to see what the prothrombin level is on the fourth day. If it is still in the therapeutic range, no drug is given on that day either. On the other hand, if the prothrombin time is rapidly becoming shorter another 100 mgm. of dicumarol are given. Other patients will be found who do not reach the therapeutic range with the first 300 and 200 mgm. of dicumarol. In these instances 100 mgm. administered on the third day and prothrombin observation is done daily after that. Sometimes even 50 mgm. are enough.

If bleeding should occur at any time during the period of treatment a transfusion of fresh citrated blood, plus 60 mgm. of water-soluble vitamin K intravenously will raise the prothrombin level promptly.

Salicylates notably aspirin, should not be given at the same time that dicumarol is being used.

Directions for the preparation of thromboplastin (rabbit's lungs) for the prothrombin test, and for the carrying out of the test are given in the original article.

From the results of the prophylactic experiments, wherein no thrombotic phenomena in 101 surgical operations were experienced, and the results of treatment of venous thrombosis and pulmonary embolism arising during the period of these experiments in 591 surgical and obstetric procedures, wherein again, dicumarol, carefully administered, resulted in uniformly favorable results (the thrombophlebitis clearing up promptly and none of the pulmonary emboli causing fatality) the authors believe that dicumarol is a safe means for preventing postoperative venous thrombosis and pulmonary embolism.

Whether this synthetic preparation should be used routinely is still a matter of discussion; nevertheless the authors are convinced that dicumarol should be given in all cases in which thrombotic complications are likely to arise including extensive pelvic operations, operations for abdominal malignancy and operations on individuals who have previously shown a tendency to thrombosis. Naturally it is the drug of choice when these conditions have already developed since it is cheaper and more readily available than heparin, and may be given by mouth. However in cases of acute pulmonary embolism it is proper to administer heparin by vein (see original article for details of technique), and start dicumarol by mouth at the same time. This should be done because dicumarol has a latent period of from 24 to 48 hours

and it is important to have the coagulation mechanism altered by the heparin until dicumarol takes effect.

Tables list the average total dosages employed by the authors for each type of operation, and for each type of case wherein thrombotic or embolic conditions have arisen, these dosages ranging from 700 to 2 100 mgm. of dicumarol. The average number of days in the corresponding therapeutic range vary from 4 to 25 days.

JOHN W. BARON, M.D.

Sharpey-Schafer E. P.: Transfusion and the Anemic Heart. *Lancet*, Lond. 1945 49 ppd.

Blood transfusion may be an essential life-saving procedure in severe anemia. The main purpose of such transfusions is to raise the oxygen-carrying power of the arterial blood by increasing the concentration of hemoglobin, and although the exact time is difficult to assess clinical evidence suggests that it is often a matter of days before improvement becomes evident. Meanwhile there is a period of risk and anxiety for it is well known that patients with severe anemia stand transfusion badly. Many of these so-called "transfusion reactions" appear to be circulatory in origin, since the clinical signs and, in fatal cases the postmortem findings show pulmonary edema. There is good evidence that the heart is not normal in severe anemia: anginal symptoms indicate myocardial ischemia, the size of the heart in roentgenogram and the weight of the heart, postmortem may be increased and electrocardiographic changes present.

The author reports the effects of transfusion on circulatory dynamics which have been studied by cardiac catheterization, a method allowing serial measurement of the output of the heart, and pressure in the right auricle.

From his observations, the author concludes that in severe anemia the blood volume is reduced, and that the right auricular pressure, cardiac output, and percentage utilization of available arterial oxygen are decreased.

Transfusion raises the right auricular pressure and in normal subjects increases cardiac output, but in severe anemia cardiac output may fall. Acute pulmonary edema follows in some cases and the blood pressure may rise.

The author suggests that the heart in severe anemia behaves like Starling's overloaded heart preparation. Starling showed that, if the rate was kept constant, raising the venous filling pressure caused a parallel rise in cardiac output until a point was reached at which a further rise in pressure caused no further rise in cardiac output, and at still higher venous pressures a fall in cardiac output resulted. In severe anemia the heart seems to respond as in this last phase, so that when the venous filling pressure is further raised by transfusion, the result is a falling cardiac output.

The purpose of transfusion in severe anemia is long term benefit from increased arterial oxygen content, while venous filling pressure is raised as

little as possible hence the small slow concentrated transfusion. Other suggestions include the propped up cardiac posture and clinical observation of venous pressure.

JOSEPH K. NARAT M.D.

Frieh, A. W. Hemolytic Transfusion Reactions Due to the Rh Factor. Report of 2 Cases. *Am J M Sc* 1945 210 184.

In 3 patients severe reactions following multiple transfusions were found to be due to the Rh factor. The first was a 24 year-old white male with Hodgkin's disease, and Group O and Rh negative blood who received 4 transfusions within 18 days without presenting any reactions. Four days later an administration of washed red blood cells resulted in hives, dyspnea and icterus. During the following 20 days, the patient received 4 transfusions of citrated blood and 2 red cell infusions each followed by chills and fever. One week following the last transfusion a warm agglutinin was detected and tested against 17 known bloods of all groups. The patient's serum proved to agglutinate 69 per cent of the bloods tested, among them being 5 Rh negative bloods. This finding is known to be characteristic for serum designated by Weiner, Sonn, and Belkin as anti-Rh₁. The second patient, a 22 year-old white male with aplastic anemia, received 15 transfusions during a period of 10 months at least 5 of which consisted of Rh-positive blood. Four months later transfusions had to be resumed but the patient showed severe reactions to small quantities of blood which proved to be Rh-positive. The patient was found to be Rh negative and therefore, received subsequently only negative donor's blood (13 transfusions). Subsequently due to lack of Rh negative donors, a transfusion of Rh-positive blood was given. This was followed by weakness, nausea, vomiting, icterus, hematuria and hemoglobinuria. The patient's condition improved after the administration of fluid. Examination of the patient's blood did not reveal any Rh-positive cells but his serum was proved to contain "blocking antibodies" as described by Wiener and Race. These inhibiting antibodies are nonagglutinating and therefore, cannot be detected by direct agglutination tests. They have to be demonstrated by the inhibition exerted by the patient's serum on the reaction between known Rh-positive cells and a known anti Rh serum.

ARTHUR J. LESSER, M.D.

RETICULOENDOTHELIAL SYSTEM

Borne, J. L., Kirkpatrick, H. J. R., Lederer H. and Lays, D. G.: Familial Crises in Congenital Hemolytic Disease. *Lancet Lond* 1945 249 33

Acute hemolytic crises form a well-recognized part of the symptomatology of familial acholuric jaundice, but the literature contains few records of these crises arising almost at the same time in several members of the same family. The authors report an instance in which 3 sons and daughters and the mother in a family of 7 mem-

bers developed acute hemolytic crises of great severity within a period of a few days of each other. At almost the same time a cousin of these children was affected by a similar crisis.

The authors made a very thorough study of these cases but no explanation could be found for their simultaneous appearance. DAVID H. LYNN M.D.

James, D. F., and Evans, L. R. Splenectomy for Acquired Hemolytic Jaundice in the Aged. *N England J M.*, 1945 233 143.

The authors present the case of a seventy year-old woman who, four months prior to her admission to the hospital first experienced malaise, increased weakness, fatigability, palpitation and shortness of breath on exertion. On admission the patient appeared to be severely ill as evidenced by prostration, tachycardia, pallor and a lemon yellow skin. The tongue was smooth and pale. The blood pressure was 130/40. There was present a loud blowing apical systolic murmur. The liver and spleen were barely palpable.

Of the significant laboratory data the red cell count was 870,000 with 17 per cent reticulocytes. The white cell count was 17,500 and the differential count was normal. The hemoglobin was 32 per cent. The icteric index was 20 and by the Sanford method of erythrocyte fragility determination, hemolysis began at n.44 per cent saline solution and was complete at n.34 per cent, both values being within the limits of normal, and equivalent to those of a normal control blood tested at the same time. When however enough plasma had been removed from the blood of the patient to make the hematocrit reading normal—that is 40—and the fragility was again tested by the Sanford method it began at n.50 per cent and was complete at 0.40 per cent, values definitely indicative of greater fragility than normal.

In order to check the findings of these naked-eye tests the photoelectric method of Hinnter was used. The blood with a hematocrit level of 17 was tested. When fragility was determined by this method hemolysis began at 0.60 per cent saline and was complete at 0.36 per cent, whereas in the normal control it began at n.48 per cent and was complete at n.34 per cent. The blood smears showed anisocytosis, macrocytes, polychromatophilia, stippling and a few erythroblasts and normoblasts. No spherocytes were seen. Routine x rays were negative. Gastric aspiration revealed free hydrochloric acid. Liver extract and multiple whole blood transfusions gave little improvement and therefore x ray therapy was administered on the supposition that the etiological process might be neoplastic in nature. This however resulted in a decrease of the white count and was therefore discontinued. Meanwhile the patient developed a severe pain in the right upper quadrant which was interpreted as due to obstruction of the cystic duct.

Because of these findings and the failure of the patient to respond to the vigorous transfusion therapy she was transferred to surgery for splenec-

tomy. At operation the gall bladder was tense and distended but no stones could be palpated. It was not removed. The spleen was removed and the pathological report was consistent with that of a hemolytic anemia. She was discharged on the twenty-second postoperative day remarkably improved, with a red-cell count of 4,300,000 and 11.5 gm. of hemoglobin. The icteric index was 14. Although abnormal red-cell fragility persisted she was entirely well and more vigorous than she had been in the previous ten years.

The authors point out that an erroneous result in red-cell fragility was obtained in the presence of marked anemia. They suggest that a more accurate test, such as Hunter's, replace the more widely used Sanford test in these cases.

The diagnosis of congenital and acquired hemolytic jaundice is discussed and the authors state that a case of hemolytic jaundice should not be termed congenital until evidence is found in the family of characteristic symptomatology or of microspherocytosis or increased red-cell fragility. Dameshek denied that increased saline fragility was pathognomonic of congenital icterus but believed it might be regarded as a regeneration phenomenon or as a sign of the action of toxic or hemolytic forces on the red cells in the circulation. Ham and Castle suggested that erythroblast in the spleen and other organs would account for increased fragility. These

observations demonstrate the difficulty in determining the fundamental nature of a hemolytic jaundice from fragility studies alone.

In the authors' case the most cogent points that argued against the congenital type were a sudden appearance of severe hemolytic anemia in old age and the absence of a familial history and the pathological picture of the spleen was not characteristic of congenital hemolytic jaundice. Therefore the diagnosis made was relatively acute hemolytic anemia of the acquired variety.

A study of the literature revealed reports of 14 patients in whom the onset of hemolytic jaundice occurred at or beyond the age of fifty, only 1 of these patients was beyond the age of seventy. Five patients showed definite improvement after splenectomy. In the other 9 patients splenectomy was ineffective.

The cases reviewed from the literature as well as the one reported by the authors demonstrate that splenectomy may save the lives of elderly patients with acquired hemolytic jaundice. Although good results following splenectomy are more likely to occur in patients with increased erythrocyte fragility, spherocytosis and a spleen typical of congenital hemolytic jaundice, splenectomy is sometimes of value in patients whose clinical picture lacks one or more of these characteristics.

DOUGLAS E. MCCROW, M.D.

SURGICAL TECHNIQUE

OPERATIVE SURGERY AND TECHNIQUE POSTOPERATIVE TREATMENT

Schwartz, L., and Mason H S: Cleansing of Oil Covered Skin and Burns. *Arch Surg* 1945 51 55

In this investigation of the cleansing of oil-covered skin and burns 165 surface active agents commercially available, were systematically studied. Some 350 mixtures of single surface-active agents or surface-active agents in combination with both light and heavy liquid petrolatum (purified mineral oil) were the subjects of approximately 700 tests of comparative activity in removing heavy fuel oil and tar from the skin. The test oils employed were heavy and light fuel oils.

Three mixtures of surface-active agents were found capable of completely removing heavy fuel oil, without ostensible mechanical action in the course of 3 fifteen minute applications on surgical gauze, but were also found to have poor detergency. Diocyl sodium sulfosuccinate in 10 per cent light liquid petrolatum solution had good detergency and high activity as an oil remover in dressing form.

SAMUEL KADAN M D

Kelly R. P. Rosati L. M. and Murray R. A.: Traumatic Osteomyelitis: the Use of Skin Grafts. *Ann. Surg* 1945 122 1

A technique for the skin grafting of osteomyelitic cavities following saucerization was employed in approximately 100 osteomyelitic wounds over a two-year period at an Army General Hospital. Beneficial results were obtained in the majority of cases.

First every effort is made to improve the patient's general condition. Saucerization is then carried out in a manner analogous to the débridement of a fresh wound. In addition, the wound topography must approach a saucer shape, to attain this one should not hesitate to sacrifice bone, provided that in so doing the surgically created bone weakness does not exceed the pre-existing weakest link. A complete removal en bloc of all unhealthy tissue and of all foreign bodies is desired. Any remaining tissue which appears to be of low vitality should be removed. Finally, any tendon denuded of its sheath or any exposed ligament which will not contribute to the anticipated function of its joint, is excised. If such a structure is vital, an effort is made to cover it with a flap of local healthy skin.

The postsaucerization dressing consists of a layer of fine mesh gauze in direct contact with the wound. Over this is packed a suitable mass of mechanic's waste and then an Ace bandage is applied with as much pressure as the wound can stand without embarrassment of the circulation. A thick layer of sheet wadding is placed over the Ace bandage and immobilization is done with plaster.

Skin grafting is usually done four days after saucerization. Uniformly healthy granulations, however thin which are visible after four days of pressure dressing are an index of a healthy wound likely to respond favorably to grafting. Grafts are cut with the Padgett dermatome. When they are applied to the wound cavity wrinkling must be avoided as well as tension. When placing of the grafts is necessary untied running sutures are placed with one end left long. These can be easily withdrawn when the graft has become firmly adherent to its bed. The margins of the graft are sutured to the skin edges with nonabsorbable material. With two exceptions the dressing is essentially the same as that after saucerization. Bono-acid gauze is preferred for contact with the graft and somewhat less pressure is applied. Better results have been obtained when the dressing is irrigated either with weak acid solution or with 1,250 penicillin. The dressings are removed in four to six days according to the amount of exudate present and moist dressings with boric acid or penicillin are continued until complete epithelization has occurred.

In evaluating the results of 47 skin-grafting procedures in 43 patients it was considered that they were poor in only 24 per cent. In the remaining 76 per cent a satisfactory take with progressive healing was obtained. In view of the beneficial results in the majority of cases it is believed that the use of skin grafting in traumatic osteomyelitis has failed to receive the general adoption its effectiveness warrants.

JOSEPH J. McDONALD M.D.

Burke J. and Jacobs, T. T.: Trans thoracic Operative Approach for Traumatic Lesions of the Spleen. *Arch Surg* 1945 51 28.

Splenic injuries are not uncommon among battle casualties and are usually associated with other intra-abdominal or intrathoracic injuries. Today the consensus is entirely in favor of splenectomy for splenic injury. The preferable incision for splenectomy in these circumstances depends to some extent on concomitant injuries.

While statistics for the authors theater of operations are not available at present observation of patients admitted from forward hospitals and conversation with other surgeons give the impression that the majority of splenectomies are performed through a vertical left rectus incision on the left side with or without a transverse extension. A few cases have been observed in which a transverse incision has been used. The authors have utilized the trans thoracic route.

At first sight it may seem that, although splenectomy may be feasible through the trans thoracic approach exploration of the peritoneal cavity will be at best, limited. Burke and Jacobs have found that it has been possible to explore the entire small

intestine the transverse and descending portions of the colon the stomach and the proximal portion of the duodenum although in 1 case a perforation high on the lesser curvature could not be visualized.

The operation has been performed with the patient under anesthesia induced with ether and oxygen administered endotracheally which permits re-expansion of the lung before closure of the wound. The chest is opened by an anterolateral incision either through the eighth interspace or through the bed of the eighth or the ninth rib. Resection of the rib seems to give a little better exposure although with the Filck rib spreader adequate exposure is obtained by either method. Phrenicostasis is not necessary to produce a flaccid diaphragm. The diaphragm is incised radially and the spleen is located and brought into the operative field without difficulty. Adhesions may be removed by sharp dissection under complete visual control. The pedicle may be ligated en masse or by separate dissection of the vessels, according to the desire of the operator. Any desired further exploration is then performed. The case with which all manipulations about the spleen may be carried out is a pleasant surprise and the splenectomy itself is much easier than through any abdominal incision. The diaphragm is closed with two rows of interrupted silk or fine chrome sutures. Whether or not the pleural cavity should be drained routinely has not been determined.

It cannot be denied that in theory at least there are dangers in connection with this approach which are not associated with an abdominal incision. The possibility of empyema must be kept in mind as well as the possibility of late herniation through the sutured diaphragm. These complications have not occurred in the reported cases nor have the authors heard of their occurrence in the cases of other surgeons in their theater of war. Three cases are reported.

BENJAMIN GOLDMAN M.D.

Maier R. L.: The Present Status of the Injection Treatment of Hernia. *Ann. Surg.* 945 22 85.

The revival of interest in the injection treatment of hernia so apparent ten years ago in many parts of the country seems to have subsided to a great degree. The author states that in the last five years he has seen no reports from responsible clinics advocating this form of treatment.

In the light of his experience in operating on 66 patients he has come to the definite conclusion that injection treatment has no place in the treatment of hernia and its use should be condemned. In 1934 after being taught injection methods by one of its ardent protagonists he treated a group of 66 patients with 93 hernias. In 1937 some 36 of these patients had been followed up and only 11 showed no definite evidence of recurrence but 9 of these were still wearing trusses. In a later check-up of these 11 cases none was found to be cured.

Because of recent experiences in treating patients by surgical repair following injection treatment, the

author believes that the injection method does not cure hernia, but actually complicates the conditions to such a degree that any subsequent attempts at surgical repair lessen the patient's chance of a cure. Marked fibroplasia, loss of tissue resiliency, semi-cartilaginous rings of tissue and cases of strangulation are but a few of the complications seen following injection treatment.

JAY P. BARTLETT M.D.

Maier G. B.: Use of Whole-Skin Grafts as a Substituta for Fascial Sutures in the Treatment of Hernias. Preliminary Report. *Am. J. Surg.* 1045 69 332.

Brigadier Edwards recently presented the modern views on the treatment of inguinal hernia in the *British Journal of Surgery*. He believes the Bassini operation is inefficient and harmful, and that it should be abandoned. In place of it he suggests a physiological repair with high ligation of the sac combined with repair of the torn or weakened transversalis fascia or a plastic repair with fascial sutures to narrow the internal ring and to strengthen the weakened posterior wall of the inguinal triangle. He believes improvement in results will come not from the evolution of new ideas but from more careful technique, better pre and postoperative care and the election of the most suitable method of repair for each case.

This article is a preliminary report suggesting that the use of whole-skin grafts inlaid under tension in such a way as to protect the posterior wall of the inguinal canal and narrow the internal ring may be superior to fascia in most cases.

Fascial sutures were first suggested by McArthur in 1901 when he cut strips from the aponeurosis of the external oblique and sutured with them. His methods since that time have not been extensively accepted, and few surgeons routinely employ this method. Kirschner first used fascia lata in 1910, and Gallie and LeMessurier advanced his work by using special needles. They showed that fascia excited no inflammatory reaction survived many years united with the tissue in which it was imbedded, and did not stretch under pressure as does ordinary scar tissue. In a few weeks the fascial strips become surrounded by a film of vascular areolar tissue from which septa of similar tissue penetrate between the folds and into adjacent structures to effect a firm union—a plaque of fibrous tissue. By 3 weeks time the fibrous strip on cross section closely resembles normal tendon.

Edwards gives as indications for fascial repairs (1) all recurrent hernias of any type (2) all primary direct inguinal hernias (3) all primary oblique inguinal hernias with muscle atrophy and weakness of the rings and posterior walls (4) all funicular or "saddle bag" types of hernia (5) the final stage in the Mayo repair of umbilical hernia and (6) the final stage in repair of large ventral or incisional hernias.

Since fascia is reserved for cases most likely to recur the evaluation of recurrence is very difficult.

For indirect hernias it averages 12 per cent. Other writers give figures between 5 and 50 per cent for indirect and between 7 and 42 per cent for direct hernias. If fascia has been used the recurrences are between 5 and 9 per cent for indirect hernias and between 7 and 9 per cent for direct. Therefore it is clear that even in a less favorable type of case fascia reduces the recurrence rate.

Fascia has the following disadvantages:

1. The McArthur method does not give enough fascia to fulfill the requirements of an ordinary case, and it is applicable mainly to the inguinal type of hernia.

2. The Gallie technique involves an extensive thigh wound or the use of a fasciotome. In either case, there may be intractable pain referred to the thigh and hip joint, and the possibility of an obvious muscle hernia. The etiology of this pain is obscure, but about 25 per cent of the cases are involved.

3. Infection of the abdominal wound more commonly follows this type of hernioplasty (7.9% of cases with autogenous fascia and 12.1% of those with or fascia).

4. There is increased liability to develop postoperative chest complications in these cases partly because of increased operative time and partly because of the decreased vital capacity and muscle spasm associated with a plastic repair.

5. Fascia unites to fascia under considerable tension, but potential gaps occur between fascia strands and all strands do not unite with one another. Recurrences usually occur between strands forming a direct sac (usually close to the medial aspect of the canal).

6. The needle used in the Gallie method is large and apt to traumatize the inguinal ligament or damage the femoral vein.

7. There is a substantial recurrence rate—the figures may be considerably higher in the hands of many surgeons.

Much research has been carried out on the use of sterilized dead fascia which overcomes many of these disadvantages. However this use has not become very popular as yet and does not seem to have affected the recurrence rate.

Rehn and Loewe advocated a method known as "cutis" graft for the repair of anatomical defects in postoperative hernias. This graft was made of all elements of skin except epidermis and was elastic, inherently active, and composed of a rich network of connective tissue fibers. These factors permit after transplantation and stimulated by the tension under which the graft is sutured it rapidly undergoes metaplasia into stout connective tissue. It has been reported that regeneration is more complete and more rapid than when fascia is used.

Wihlein, operating on 2 patients who had submitted to cutis grafts 4 years before found complete metamorphosis of the transplants. The grafts represented normal connective tissue and no hair follicles or glandular tissue could be identified. There was no evidence of cyst formation.

Rehn used this method in 104 operations with 15 cases of wound sepsis and 6 poor late results. Cannaday declares these grafts are superior to fascia and that the grafts heal firmly and promptly and are easily obtainable. He used these grafts for 37 operations (27 hernias) with only 2 cases showing mild sepsis and 2 small hematomas.

Eitner and Peer and Paddock found that it is impossible to remove every bit of the epidermis; the splices of hair follicles and the sweat glands remaining. After implantation these disappear and the grafts fuse with their surroundings through a mechanism of inflammation and aseptic wound healing.

Many investigators have shown that epidermis alone implanted in the skin will produce smooth walled cysts which contain no dermal elements. Peer and Paddock and Rehn and Cannaday and his associates have done work showing that the method is entirely safe and the risk of epidermoid cyst formation is remote. It is important that the grafts be placed under tension since metaplasia is then much more rapid and complete.

Rehn originally denuded an area of the thigh of epidermis with a Thiersch razor and cut the cutis graft from this. The edges of the resulting wound were devoid of epithelium and healed slowly when closed. The author wondered if it really was necessary to remove the epidermis and investigated the use of whole-skin grafts sutured under tension in guinea pigs and rabbits. At the same time he applied the operation to a considerable number of hernias in which fascia would have been used.

In 1938 the author first used a whole-skin graft in repairing a large ventral hernia. The graft measured 4 by 5 inches and was sutured to the anterior aspects of both rectus sheaths and the medial aponeurotic expansions of the external oblique. The repair was firm and satisfactory 18 months later with no recurrence or other complication. He later used the same method (from 1938 to 1943) on 7 large ventral, 3 umbilical hernias, and 1 epigastric hernia without complication. Follow-ups have been complicated by the war but immediate results were very encouraging and the author began applying the same methods to the repair of inguinal hernias.

Experimentally the author used whole skin grafts under tension to close fascia defects in rabbits. The first group with hair left to a length of 5 mm when examined five months later showed disappearance of the sebaceous glands, epidermis and hair follicles. The hairs were surrounded by a massive foreign body reaction and this in turn was encapsulated by a firm fibrous stroma. The degree of metaplasia was striking and microscopically the edge of the graft was determined with difficulty. Under the microscope a few atrophic sweat glands and dermal papillae were seen. The dermis showed a dense fibrous tissue infiltration and high vascularity.

A second group with the hair shaved off, showed similar findings with a less intense foreign body reaction. No trace of epidermoid cyst formation was

seen. Instead, the epidermis was being desquamated and the cells and debris were being removed by phagocytes.

The author explored an inguinal canal in a human being into which a whole skin graft had been sutured for a large direct hernia three months before. The graft was firmly attached to Poupart's ligament the medial aponeurotic aspect of the internal oblique, and the insertion of the rectus sheath in the pubis. The edges of the graft could not be ascertained with certainty and the appearance closely resembled a normal inguinal canal. The dense fibrous tissue and deformity of anatomy seen in the recurrent fascial repairs were absent. The graft microscopically showed highly vascular connective tissue without dermal or epidermal elements. No hair remnants were found. Microscopically no evidence of cyst formation was seen—only a number of giant cells.

The author believes that no contraindication to the use of these grafts in human beings has been found to date and he used them in a series of 119 inguinal hernias of all types 6 umbilical hernias 10 ventral, 1 femoral hernia and 1 epigastric. In this group there were 2 cases of mild sepsis 1 case of scrotal hematoma, and 12 cases of mild postoperative bronchitis. Late postoperative complications have not been seen, and as yet it is too soon to study recurrency figures. The author prepares the skin (for three days) by careful shaving and washing with ether soap and warm water for 10 minutes. Spirit compresses and a sterile bandage are then applied. He suggests a gas-oxygen-ether or spinal anesthesia to give maximum muscle relaxation so the graft can be placed under maximum tension. The skin for the graft is encompassed on the original incision and measures about 8 by 1. It is prepared by removing the subcutaneous fat. The ends are cut off, and the graft is split for a distance of $\frac{3}{4}$ inch down one end. The graft is placed in the inguinal canal, and the apex of the V is brought around the cord. Three 30-day chronic sutures are used to hold the medial margin of the graft to the lower aspect of the rectus sheath, the fascia over the symphysis and the medial edge of Poupart's ligament. The graft is then sutured to the shelving edge of Poupart's ligament and the aponeurotic medial edge of the internal oblique with sutures $\frac{3}{4}$ inch apart. Care is taken that the graft be sutured under great tension. The outer pedicles of the graft are then joined laterally to the internal ring and outside of the emerging cord.

The patients are allowed up on the twentieth day since fascia does not heal firmly in less than three weeks. The same principles can be adopted for direct hernias and whole skin grafts can be used for final re-enforcements for umbilical, ventral, and epigastric hernias. ROBERT R. BRIDGEMAN M.D.

Green R. W. Levenson, S. M., and Lund, C. G.: Nylon Backing for Dermatome Grafts. *N Eng J Med* 1945 233 268.

In the use of the drum technique of skin grafting, as described by Padgett in his book on skin grafting

(Springfield Charles C. Thomas, 1945) some surgeons have been using a backing on the drum, such as plex film (Webster) and cellophane (Evans). The author suggests a fine-gauge nylon cloth for the same purpose. Before the graft is cut the drum is coated with dermatome cement and the backing is cemented to the drum as smoothly as possible. New coats of cement are then applied to the backing and to the donor site and the graft is cut as described by Padgett. The graft with its back is removed from the drum and placed on the recipient site. No sutures are needed to maintain the graft at its original size and tension, it being merely maintained in place by even elastic pressure provided by a suitable pressure dressing with or without external splinting.

The advantages claimed by the author for his nylon-cloth backing are (1) that nylon can be sterilized as easily as any textile and is physically unchanged after sterilization and (2) that grafts backed with nylon conform better to irregular surfaces than do those backed with cellophane, yet in spite of the relative limpness of the nylon before it is attached to the skin it prevents contraction of the graft as well as cellophane or sutures.

A case history is given and 6 figures to illustrate the method and the results of treatment.

JOHN W. BRIDGEMAN, M.D.

ANTISEPTIC SURGERY TREATMENT OF WOUNDS AND INFECTIONS

Harkins, H. N., Cope O., Evans, E. I., Phillips, R. A., and Richards, D. W., Jr.: Therapy of Burns. *J Am Med Ass* 1945 138 475.

This memorandum is released by authorization of the National Research Council and Office of Scientific Research and Development. Chemotherapy with penicillin and sulfonamides is not within the scope of the present discussion.

Following burns, there is loss of extracellular fluid salts and plasma. In patients with minor burns involving less than 10 per cent of the body surface it is generally agreed that restitution takes place by the ingestion of fluids and food, according to the desires of the patient. However in patients with severe second-degree or third-degree burns of at least one of the following areas (face and neck, dorsal or ventral surface of chest, dorsal or ventral surface of abdomen, upper extremity and dorsal or ventral surface of lower extremity) parenteral fluid administration is necessary.

Three dangerous phases are observed in severe, and inadequately treated, burns.

1. Shock may be present for as long as 48 hours after the burn but clinical signs may not be obvious since generalized vasoconstriction may keep the blood pressure at satisfactory levels even though cardiac output is greatly diminished. Therefore, vigorous fluid therapy is essential during the first 3 days of every case of severe burn.

2. The period of toxemia (from 48 to 128 hours occasionally up to the third week) is manifested by

fever jaundice, anuria stupor delirium and circulatory collapse

3. The third phase is defined as the period of burn anemia and hypoproteinemia

Fluid therapy should be directed toward rapid replacement of acute deficits and the maintenance of daily needs. In severe burns involving from 30 to 40 per cent of the body surface from 8 000 to 15 000 c.c. of fluid in a period of 24 hours may be necessary. The dosage of plasma can be estimated by giving 100 c.c. for each point of hematocrit exceeding the normal of 45 (or for each 100,000 the red blood count exceeds 5,000,000) or 50 c.c. of plasma for each per cent of the body surface that is involved by a deep burn.

Iso-osmotic human albumin solution is a satisfactory substitute for blood plasma.

In patients with hematocrit readings below 60 about 500 c.c. of blood should be given with every 1,000 c.c. of plasma.

An attempt should be made to maintain the urinary output above 100 c.c. per hour for the first 48-hour period; however an initial period of anuria lasting from 4 to 5 hours is not uncommon.

If the plasma carbon dioxide is less than 55 vol umes per cent 40 c.c. of 4 per cent sodium bicarbonate intravenously or 125 c.c. of 1.3 per cent sodium bicarbonate or 185 c.c. of 1.75 per cent sodium lactate should be given for each point of carbon dioxide below 55.

After a period of 48 hours excessive fluid administration should be avoided because of the danger of circulatory embarrassment and pulmonary edema. The aim then, is to maintain water and salt balance and to raise the hemoglobin to 85 per cent and the protein blood level above 6 gm. per 100 c.c. Blood transfusions and daily intravenous administration of amino acids in amounts up to from 100 to 150 gm in a 10 per cent solution, are indicated.

Oral therapy also is very important and should consist of from 3 000 to 4,000 c.c. of fluid in order to insure 1 500 c.c. of urine daily. Ten grams of sodium chloride are given daily, and a diet of from 3,000 to 5,000 calories composed of from 200 to 300 gm. of proteins and if tolerated 100 to 300 gm. of amino acids along with large doses of carbohydrates vitamins and iron.

ARTHUR J. LASKER, M.D.

Flemming, C. W. The Treatment of Burns; A Plan for Simplicity. *Brit M J* 1945 2 314.

General Mitchiner's quotation, "It can be said truthfully that the treatment of burns has returned to chaos" forms the subject of the author's article.

In the present state of our knowledge the treatment of burns must be to some extent empirical, because the pathological processes which make the patient ill or cause his death are as yet not fully understood. However by careful observation of those signs and symptoms which are comprehensible a high standard of treatment can be achieved function can be preserved and lives saved. There is no single all-embracing universally applicable

treatment for burns and never will be. The surgeon must vary his detailed technique from case to case as in any other branch of surgery.

Severely burned patients travel badly until their general condition is stabilized which usually takes from 4 to 10 days.

From the clinician's point of view burns are of two degrees slight and severe. Slight burns are those in which there is no detectable disturbance severe burns are those in which the general treatment of the patient is more urgent than the local treatment of the burn.

There are three types of local dressings available for the treatment of slight burns (1) wet dressings of saline solution or antiseptic which should be changed at intervals (2) occlusive dressings of tannic acid or dyes and (3) greasy dressings. A wet dressing is suitable for a fresh burn which has not been cleansed or an old one which has become septic. An occlusive dressing is successful if the wound is clean and the burned area one that is relatively immobile. It is therefore not good as a first-aid dressing, nor for the fingers face, and flexures. Greasy dressings are very comfortable and proper on the face and fingers but should not be used too continuously as the raw surface gets grease-lodged and indolent. They are very satisfactory as the skin heals.

In every case of severe burn there is a series of symptoms and signs which must be looked for and if found treated. The details of treatment vary but particular points should be checked over in each patient.

1 Any case assessed as a severe burn, at first requires intravenous plasma. It is extremely valuable to have an estimation of the hemoglobin before treatment is started, and essential to have this determination made as soon as possible from beginning to end the chart of the hemoglobin percentage is as important as that of the temperature and pulse. Glucose-saline solution should be given intravenously until it is apparent that the patient can drink enough, without vomiting to prevent dehydration. A fluid-intake-and-output chart gives the surgeon complete information on this point.

2 As to local treatment, despite the early appearance of organisms in a burned area there is no desperate rush to get at the wound. Under morphine alone the burned areas are cleansed with aseptic precautions blisters snipped and the wounds very carefully dressed with tulle gras or vaselined gauze. The ends of the fingers are guarded by a Cramer wire splint which projects beyond the tips. Morphine is given for pain.

3 It is advisable to leave the dressings untouched for 4 days at least. In the interval the patient needs fluids, glucose and rest. If his burns are reasonably comfortable he will sleep better with a hypnotic than with morphine.

4 After from 3 to 7 days according to the general condition, it is time for the first dressing. For an extensively burned patient there is nothing

seen. Instead, the epidermis was being desquamated and the cells and debris were being removed by phagocytes.

The author explored an inguinal canal in a human being into which a whole skin graft had been sutured for a large direct hernia three months before. The graft was firmly attached to Poupart's ligament, the medial aponeurotic aspect of the internal oblique and the insertion of the rectus sheath in the pubis. The edges of the graft could not be ascertained with certainty and the appearance closely resembled a normal inguinal canal. The dense fibrous tissue and deformity of anatomy seen in the recurrent fascial repairs were absent. The graft microscopically showed highly vascular connective tissue without dermal or epidermal elements. No hair remnants were found. Microscopically no evidence of cyst formation was seen—only a number of giant cells.

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Green, R. W. Levenson, S. M. and Lund, C. G.: Nylon Backing for Dermotome Grafts. *V. Eng-land J. M.* 1945 233: 268.

In the use of the drum technique of skin grafting, as described by Padgett in his book on skin grafting

(Springfield Charles C. Thomas 1943) some surgeons have been using a backing on the drum such as plico film (Webster) and cellophane (Evans). The author suggests a fine-gauge nylon cloth for the same purpose. Before the graft is cut the drum is coated with dermatome cement and the backing is cemented to the drum as smoothly as possible. New coats of cement are then applied to the backing and to the donor site and the graft is cut as described by Padgett. The graft with its back is removed from the drum and placed on the recipient site. No sutures are needed to maintain the graft at its original size and tension, it being merely maintained in place by even elastic pressure provided by a suitable pressure dressing with or without external splinting.

The advantages claimed by the author for his nylon-cloth backing are (1) that nylon can be sterilized as easily as any textile and is physically unchanged after sterilization and (2) that grafts backed with nylon conform better to irregular surfaces than do those backed with cellophane, yet in spite of the relative limppiness of the nylon before it is attached to the skin it prevents contraction of the graft as well as cellophane or sutures.

A case history is given and 6 figures to illustrate the method and the results of treatment.

JOHN W. BRIDGEMAN, M.D.

ANTISEPTIC SURGERY TREATMENT OF WOUNDS AND INFECTIONS

Harkins, H. N., Cope, O., Evans, E. I., Phillips, R. A., and Richards, D. W. Jr.: *Therapy of Burns. J. Am. M. Ass.* 1945 13 475.

This memorandum is released by authorization of the National Research Council and Office of Scientific Research and Development. Chemotherapy with penicillin and sulfonamides is not within the scope of the present discussion.

Following burns, there is loss of extracellular fluid salts, and plasma. In patients with minor burns involving less than 10 per cent of the body surface, it is generally agreed that restitution takes place by the ingestion of fluids and food, according to the desires of the patient. However, in patients with severe second-degree or third-degree burns of at least one of the following areas (face and neck, dorsal or ventral surface of chest, dorsal or ventral surface of abdomen, upper extremity and dorsal or ventral surface of lower extremity) parenteral fluid administration is necessary.

Three dangerous phases are observed in severe and inadequately treated burns:

1. Shock may be present for as long as 48 hours after the burn, but clinical signs may not be obvious since generalized vasoconstriction may keep the blood pressure at satisfactory levels even though cardiac output is greatly diminished. Therefore, vigorous fluid therapy is essential during the first 3 days of every case of severe burn.

2. The period of toxemia (from 48 to 128 hours, occasionally up to the third week) is manifested by

In some of the more advanced cases a typical change in skin coloring i.e. a bluish brown tinge not only of the skin around the wound but also of the face the lips and the body in general was noticed. Pulse rates were frequently above 120 and temperatures ranged from 100 to 102 F. In spite of sulfonamide therapy, anemia was found to be out of proportion to the estimated blood loss. Wound odor best described as rotten or decaying meat or "mousy" was noticed in only one third of the cases and crepitus was found only occasionally. Gas gangrene occurred in the following regions in order of frequency buttocks thighs shoulders upper and lower extremities.

Treatment consisted of measures against shock and anemia followed by early radical and extensive debridement. Foreign bodies pieces of clothing and dirt, were carefully removed in order to prevent recurrence, and all damaged muscle tissue was excised. Sulfonamide compounds proved of little value against clostridia but were very effective against other contaminants. Penicillin in large doses applied locally intramuscularly and intravenously was found to be an excellent adjunct, but only if used in conjunction with surgery and antitoxin. Gas gangrene antitoxin was given after surgery in doses corresponding to the degree of toxemia. In the absence of sensitivity a minimum of 18 therapeutic doses were given, each containing 10,000 units of antitoxin against clostridium welchii and clostridium septicum, and 1,500 units of the antitoxin against clostridium oedematiens. Preoperative administration of antitoxin appeared to be of little value.

Eleven (11.5%) of the 96 patients died as the direct result of gas-gangrene infection.

ARTHUR J. LEASER, M.D.

Walker Taylor P. N.: The Treatment of Tropical Ulcer. *Lancet Lond.*, 1945 149 40.

Tropical ulcer is an acute process usually seen in West Africa. The ulcer located on the lower leg or foot, is a dirty sharply marginated lesion, the base of which is covered by a dark purulent slough and the ulcer is surrounded by a zone of edema. The patient with this disease is not obviously ill and suffers little pain.

Good results were obtained by the following simple measures:

1. Elevation of the limb to reduce the edema and improve the circulation
2. The application of moist warm dressings
3. The topical use of penicillin or a sulfonamide dusting powder

4. Early skin grafting if the ulcer is large. The same disease may affect the toes and is then called ulcerative onychia. On a toe the ulcer develops under the nail or under the cuticle. It is often necessary to cut away the dead nail and the dead cuticle in order to establish drainage. The drainage trench is then packed open at each dressing. Other than the treatment of ulcerative onychia is the same

as in cases in which the ulcer is found on the leg or foot.

Three complications are mentioned: fibrosis of the ulcer bed in long-standing cases; infestation with the guinea worm; and osteomyelitis.

The average period of incapacity of the patient after admission was 37.2 days.

DAVID H. LYNN, M.D.

Archer G. T. L.: Bactericidal Effect of Mixtures of Ethyl Alcohol and Water. *Brit. M.J.*, 1945 2 148.

The author has re-studied an old but still important problem and has utilized satisfactory technical methods in well controlled experiments. His findings are valuable and apparently his conclusions represent a significant addition to the practical information available.

To test the bactericidal effect of various dilutions of ethyl alcohol, 30 experiments employing 6 different methods were carried out. From the practical point of view, this work was done to determine the optimal dilution for use on the skin. When alcoholic solutions were applied to the normal or moist skin the findings differed from those obtained with the application of solutions of equal strength to dry surfaces.

It was found that on a dry surface the effective range of strengths of alcohol for the killing of non-sporing bacteria is between 90 per cent and 50 per cent. Solutions of 95 per cent and above were found to be partially ineffective and solutions of 100 per cent, markedly so. On the skin the results were different because the normal skin is more or less moist. On the skin, 100 per cent alcohol was commonly found to be effective especially on moist skins and under tropical conditions of temperature and humidity whereas under similar conditions concentrations of 60 per cent to 65 per cent showed a certain loss of efficiency. Therefore the author recommends that as a rule and under all climatic conditions 80 per cent alcohol is probably the strength most suitable for sterilization of the skin.

Ether was found to be quite ineffective as a sterilizing agent for the skin, since its effect is very slight on staphylococci and streptococci although it is effective against certain bacillary forms.

DAVID H. LYNN, M.D.

Lovell D. L.: Penicillin: Its Tropical Use as a Bacteriostatic Agent for the Palliative Treatment of Chronic Stasis Ulcers of the Lower Extremities. *Arch. Surg.* 1945 51 22.

The secondary infection in chronic stasis ulcers responds readily to topical applications of penicillin. This drug is thought to be superior to other bacteriostatic agents that are generally used for this purpose. In the early stages of the condition rapid healing occurs when the infection and stasis are controlled. Healing is delayed in the cases of chronic ulceration because of extensive fibrosis of the edges and the poor arterial blood supply.

BENJAMIN GOLDMAN, M.D.

which makes him so comfortable or the dressing so easy as a bath. In the early stages during the separation of sloughs, a daily bath seems best. Later when the wound reaches the healing stage, it may make the granulations soggy.

5 Food with extra proteins is the next care. Equally important is attention to the bowels.

6 The hemoglobin should be checked at any time that the patient's condition causes anxiety or if progress is slow and always on the tenth day. If it is below 80 per cent it should be checked daily and if it continues to fall a blood transfusion should be given.

7 As the patient's general condition improves first-aid grafting where skin has been destroyed becomes urgent.

JOSEPH K. NARAT M.D.

McCartan, W., and Fecitt, E.: First Aid for Phosphorus Burns. *B U I J* 945, 316.

The facility with which copper combines with active phosphorus to form copper phosphide has been the basis of most methods of first-aid treatment of persons contaminated with phosphorus. The standard treatment suggests that the burning phosphorus should be extinguished with water and by keeping the burned area damp. The burn is treated with aqueous solutions of sodium bicarbonate and copper sulfate. The principal objections to this treatment are that such solutions are cumbersome to carry and are not likely to be immediately available in civil defense and under active service conditions although speedy application is, of course, all-important. Also the number of persons contaminated may be so large that immediate active surgical attention to all is not possible and in the meantime it is necessary to repeat the application of the solution—not the best treatment for an already shocked patient. There is further the danger that repeated applications of fluid may wash particles of phosphorus to the periphery with the risk of peripheral burns.

The danger of phosphorus-containing incendiaries during air attacks led the authors to investigate this matter with a view to producing a substance which fulfilled the following requirements: (1) it should be readily available in a compact form; (2) all of the remedies should be contained in the one compound; (3) it should immediately extinguish the phosphorus and inactivate the products of phosphorus combustion, i.e. phosphorus pentoxide and phosphoric acids; (4) it should be viscous and stick to the skin so as to remain in position, and also hold the particles of phosphorus in situ; and (5) it should be easily removed by warm water.

The authors employed *sapo mollis* as the base for incorporating copper sulfate, and developed a compound with a final content of 4 per cent of copper salts. The damage to tissue by burning phosphorus is thought to be due not only to the heat of combustion and to the corrosive action of the phosphoric acids formed as the terminal result of such combustion, but also to the intensely hygroscopic action

of phosphorus pentoxide, which is formed in the intermediate stage of the change. Phosphorus pentoxide "mops up" water with great avidity and with the production of intense heat. According to the authors when a film of water sufficient to extinguish the phosphorus flame is applied to the skin, it will not be adequate to provide the pentoxide with enough water to supply its needs; thus tissue fluid is called on and this produces further damage. For this reason a high proportion of water is mixed with the compound. It was also believed that water loosely held in depth over the area by such a compound might act as a better conductor of heat than air and that in this way the heat generated by the change— $P_2O_5 + 3H_2O \rightarrow 2H_3PO_4$ —would be more easily removed from the site of the injury.

A 25 per cent solution of copper sulfate in water is prepared and the requisite amount of this to give a final content of 4 per cent copper salt is heated in a boiling flask. *Sapo mollis* is heated in a water bath, and the copper sulfate solution is added hot by constant trituration on a slab. Copper precipitates as oleate, and this is thoroughly incorporated into the base between each addition. It is advisable to add the copper sulfate solution in small successive portions. The resulting compound is a homogeneous mass and samples have kept very well for at least twelve months. The pH of the final compound, determined electrically is 8.65 at 19°C. and 8.25 at body temperature.

The authors conclude from results of animal experimentation and observations on clinical material that copper sulfate ointment in addition to being an excellent first-aid measure for phosphorus burns is of value in the healing stages also since it has reduced the healing time of burns in striking fashion. The authors suggest that it be combined, in subsequent treatment, with sodium bicarbonate solution because the latter allows easy removal of the ointment if the burn is to be inspected, assists in the disposal of any phosphorus which may still persist after ointment treatment and tends to reduce the healing time of the burn.

JOSEPH K. NARAT M.D.

Langley, F. H., and Winkelstein, L. B.: Gas Gangrene. A Study of 96 Cases in an Evacuation Hospital. *J Am Med Ass* 945 28 783.

Ninety-six cases of clinical gas gangrene infection were observed at an evacuation center in northern France during the period between July and December 1944. The average incidence of gas-gangrene infections per 1,000 battle casualties was 16. The incidence was highest in prisoners of war (63 per 1,000 battle casualties) and was considerably lower in American and Free French troops (9.9 per 1,000 and 12.3 per 1,000 respectively). The higher incidence in the prisoners of war is explained by the longer intervals between the time of the initial injury the first-aid dressing and the surgical repair.

Early general signs of gas gangrene were (1) pain (2) tightness of the dressing and (3) signs of toxic

The average dose of sodium pentothal was 23 c.c. and the average dose of curare was 80 units. The duration of postoperative narcosis was minimal. All but 40 patients left the operating room either awake enough to open their eyes and respond or with an adrenergic reflex.

MARY KARP M.D.

Knight R. T. and Baird J. W.: Prolonged Anesthesia. *Surgery* 1945 18 33

A report is made of 1,000 consecutive operations which required anesthesia of three hours or more duration, and were collected in a period of about three years. This series has been tabulated with regard to the average age of the patients, preoperative conditions, preoperative medications and anesthetic agents used.

Morphine and scopolamine became the anesthetics used preoperatively in most cases although morphine was not given in the brain cases.

Spinal anesthesia has gained in popularity in the past year a long-acting single dose of the anesthetic being preferred to the continuous technique.

Cyclopropane without any addition of ether was used in the more recent group of operations but a sufficient concentration of the drug was employed to produce apnea and then artificial or controlled respiration was induced by manual manipulation of the breathing bag. Excellent muscle relaxation was produced, and the operative and postoperative course and the recovery time of these patients were found to be better than with any preceding type of anesthesia.

The combination of single-dose spinal anesthesia with cyclopropane and controlled respiration gave an excellent picture with an even better postoperative course, less prostration, and more rapid recovery of vigor than was found in patients who had been anesthetized by cyclopropane alone.

Curare was added to the armamentarium in May of 1943 and it became increasingly popular as time went by. Its special advantages were the lessened incidence of catheterization and headache as compared with spinal anesthesia.

Of 130 cases of brain surgery 103 received cyclopropane and in most of the cases an intratracheal tube was inserted. All major chest surgery was accomplished under cyclopropane given intratracheally. The inflatable cuff which was used around the intratracheal tube was described and the advantages are mentioned.

A discussion of cautery and fulguration in relation to the agent used was given with the conclusion that the type of anesthesia used and the benefit of the cautery or fulguration were both too advantageous to be given up in view of the closed system of anesthesia and careful draping. With hundreds of trials the authors have been unable to pick up an explosive sample of gas farther than 3 inches from the wide-open end of the gas tubing.

Postoperative pulmonary complications occurred following 84 of the 1,000 long surgical procedures.

MARY KARP M.D.

Baptist A. Jr. Five Years Experience with Caudal Anesthesia in Private Obstetric Practice. *Am J Obst.* 1945 50 180.

In five years 318 obstetric cases were delivered under caudal anesthesia by the author and seen for the routine six weeks of postpartum check up examination. Forty five of the total represent obstetric complications such as breech presentations or transverse arrests in which procedures other than outlet forceps deliveries were done. Many of these were seen in consultation. In every case but one the anesthesia was excellent and no supplementary anesthetic was required. In one case in which the outlet was directly posterior and delivery was prolonged (arrested second stage) unilateral anesthesia only was obtained and inhalation anesthesia was necessary. One cesarean section was done in this group of 45 cases but supplementary anesthesia was unnecessary. Caudal anesthesia for cesarean section is hazardous because the solution must be driven higher than usual to get satisfactory anesthesia and this carries an increased risk of vascular collapse.

The remaining 273 cases represent normal obstetric patients who were delivered under caudal anesthesia by means of elective outlet forceps. All had had perineotomy.

This total group of 318 cases in 316 of which caudal anesthesia was entirely satisfactory, represents an attempt to administer caudal anesthesia in 320 cases. In 2 cases the caudal canal could not be entered although it seemed clearly palpable.

In the total group of 318 cases there was no maternal mortality and no complication from the anesthetic, either maternal or fetal. One stillborn fetus was delivered by breech extraction after a prolonged second stage of labor the baby having died in utero before the patient was seen in consultation. One other baby died 4 days postpartum from erythroblastosis. All of the other babies were born in excellent condition. Caudal anesthesia offers a tremendous advantage in delivery of the premature infant. The technique is described.

EDWARD L. CORNWELL, M.D.

Kremer M.: Meningitis after Spinal Analgesia. *Brit M J* 1945 2 309

The possibility of introducing infection into the subarachnoid space by spinal tap has been recognized from the time that lumbar puncture was first performed, and this possibility must be considerably increased if anything is injected into the theca. If infection is introduced along a needle track it may obviously lodge anywhere in the course of that track. With lumbar puncture the possible localities are the skin, subcutaneous tissues, vertebrae, epidural space, and subarachnoid space.

The author reports 7 cases of meningitis following spinal anesthesia and 1 case following diagnostic lumbar puncture. The condition is a low-grade meningitis caused by a variety of organisms introduced at the time of lumbar puncture. The main clinical features are the chronic nature of the illness

Finland M., Miesda, M., and Ory E. M.: Oral Penicillin. *J Am M Ass* 945, 1945, 315.

A dose of 90,000 units of penicillin given by mouth one-half hour before breakfast, regularly gave serum levels comparable with those obtained from 15,000 or 30,000 units given intramuscularly. The levels obtained in the serum when the same amount of penicillin was given one-half hour after breakfast were quite varied and unpredictable.

As compared with normal persons achlorhydric individuals had more sustained serum levels from oral penicillin taken before a meal, and after the postprandial dose they had higher as well as better sustained levels than normal persons.

The serum levels obtained with ordinary penicillin in saline solution were at least as high and as well sustained as those obtained with any of the special oral preparations tested. This was true when the drug was given both before and after meals except, possibly when aluminum hydroxide gel was used in addition to the saline solution of penicillin after a meal.

Effective penicillin levels could be fairly well maintained with several oral preparations given in 90,000 or 100,000 unit doses every 2 hours.

The results of preliminary clinical trials in gonorrhea and in pneumococcal pneumonia suggest that oral penicillin therapy is feasible in these conditions. They also suggest that oral therapy should prove effective in other infections in which low doses of parenteral penicillin have proved adequate. Penicillin should be given parenterally to initiate therapy in all infections which are severe, and in those which require prolonged treatment with parenteral doses as shown by experience. SAMUEL KAHN, M.D.

Ross, S., and McLendon P. A.: Penicillin by Mouth. *J Am M Ass* 1945, 190, 37.

Adequate therapeutic blood concentrations of penicillin, after oral administration, can be obtained when the drug is protected against inactivation by gastric acidity. A method of providing this protection, by the use of a double gelatin capsule hardened by formaldehyde-alcohol immersion, together with preliminary neutralization of the hydrochloric acid in the stomach, was adopted.

Administration of a 100,000 unit capsule every 3 hours, by this method, provides constant therapeutic penicillin levels well within or above the effective antibacterial range of most susceptible organisms throughout the course of treatment.

A clinical trial of this method on 10 children with gonorrhea 2 with pneumonia, and 2 with cellulitis resulted in prompt recovery.

The relatively large doses of penicillin employed produced no toxic manifestations.

SAMUEL KAHN, M.D.

Turton, E. C.: Penicillin by Intramuscular Infusion. *Brit. M J* 945, 83.

The author summarizes his experience after treating 30 patients with continuous and intermittent

intramuscular injections of penicillin. The instrument used for the continuous intramuscular drip was the Endrip 2 (McAdams *Lancet*, 1944, 2, 336). The intermittent injections were administered by the nursing staff after it had been instructed by medical officers.

All patients were located in a 30-bed ward and had been especially selected as having severe compound fractures.

Of the 30 patients 24 were quite emphatic that they preferred the continuous intramuscular drip to the intermittent injections. By 4 in whom both pectoral and thigh regions were injected the thigh was strongly preferred but the patients disliked frequent changes of the site of injection. At first the needles were changed every third or fourth day but later the tendency was to leave them in longer at the most for seven days.

Fifteen patients admitted to some tenderness over the needle site but pain was not a feature of the drip in any instance. Subsequent stiffness of a limb with delayed return to full function was not found in any case nor was there any abscess formation or pus in the needle tract.

The general impression at the end of the series was that continuous intramuscular infusion is the method of choice for the patient and no more laborious than the intermittent injection.

LEONARD J. PROUDMAN, M.D.

ANESTHESIA

Brady J.: The Use of Curare in Sodium Pentothal Nitrous Oxide Oxygen Anesthesia. *Asthma* 945, 6, 38.

The author reports the use of curare in sodium pentothal nitrous oxide oxygen anesthesia for 30 consecutive surgical operations in which relaxation was excellent. The initial dose of sodium pentothal is injected intravenously in an amount sufficient to produce narcosis to a level at which there is no response to questions. Two liters of oxygen and 2 liters of nitrous oxide are then administered by the semi-closed carbon dioxide technique. When the skin is incised, an initial dose of from 60 to 80 units of curare is given intravenously from a small syringe, separate from that used for the sodium pentothal. Additions of 20 units may be necessary when the peritoneum is opened. In operations lasting longer than from 30 to 45 minutes supplementary doses of from 20 to 40 units are administered to maintain relaxation and sodium pentothal is injected intermittently to maintain anesthesia.

The curare depression can be effectively overcome by the intravenous use of from 1 to 2 c.c. of a 1:1000 solution of prostigmine, plus complementary support of inadequate respiration.

Relaxation of muscles and peritoneum has been comparable to that seen in spinal anesthesia. The preanesthetic medication was morphine sulfate and atropine sulfate given hypodermically 1½ hours before the scheduled time of operation.

The average dose of sodium pentothal was 23 c.c. and the average dose of curare was 80 units. The duration of postoperative narcosis was minimal. All but 40 patients left the operating room either awake enough to open their eyes and respond or with an active lid reflex.

MARY KARP M D

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EDWARD L. CORRYALL, M D

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The author reports 7 cases of meningitis following spinal anesthesia and 1 case following diagnostic lumbar puncture. The condition is a low grade meningitis caused by a variety of organisms introduced at the time of lumbar puncture. The main clinical features are the chronic nature of the illness.

and the tendency toward relapse. It is suggested that this is due to the formation of adhesions containing infected cerebrospinal fluid which is liberated from time to time. These adhesions may cause spinal block or hydrocephalus.

Three theories have been advanced to account for the production of this form of meningitis.

The chemical theory suggests that the condition is entirely due to the irritating action of the spinal anesthetic and that infection plays no part. There is good evidence of the irritating effects of the spinal anesthetics but it would appear that with ordinary clinical dosage this irritation comes on at once is short lived, and quieted down without relapse as the irritant is disposed of.

The next possibility is that the meningitis is secondary to infection elsewhere in the body. As a secondary meningitis is not possible in the clean cases one may argue that it is an unlikely explanation in the others.

The third possibility is that the meningitis is due to the introduction of infected material along the lumbar puncture needle. It is true that in a number of cases it has not been possible to isolate the organism as might be expected in an infectious condition. The author stresses the point that failure to cultivate an organism is compatible with an infectious origin. This is not infrequently seen in the meningitis which follows open wounds of the brain—an infectious condition by all other standards. The delay which usually occurs between the operation and the onset of meningitis is very suggestive of a phase of multiplication of an organism as a preliminary factor to the phase of clinical activity. Probably the most convincing evidence in favor of the infectious theory is the cessation of fresh cases with the enforcement of aseptic technique. There can be little doubt that the spinal anesthetics are mild irritants and it is possible that the reaction to this irritation with the outpouring of protein-rich fluid gives reasonable conditions for an organism to gain a foothold.

The only satisfactory treatment is prophylaxis. It should be possible to avoid these unhappy cases completely. If because of an emergency a rigid technique is not possible, then spinal anesthesia should not be used. Unfortunately the causal organism is often not susceptible to present-day chemotherapy i.e. sulfonamides and penicillin but this should not prevent an early adequate trial of these substances. The formation of adhesions causing spinal block is common and calls for no special treatment but if hydrocephalus occurs surgical relief may be necessary.

JOSEPH K. NARAY, M.D.

Stevens, E. J.: Pentothal Sodium: Its Use in Continuous Intravenous Anesthesia and a Method of Preserving It in Solution. *Anesthesiology* 1945 6 376

Various methods have been advocated for the administration of pentothal sodium. The author

reports his experience with the use of 0.4 to 0.1 per cent (1:250 to 1:1000) dilutions of the agent in 100 cases. The 0.4 per cent dilution is made by adding 4 gm. of pentothal sodium to a regular commercial liter bottle of 5 per cent glucose in normal saline solution. A glass drip meter is inserted into the bottle and a screw clamp is used on the tubing to regulate the flow. A No. 18 gauge needle is usually recommended to permit rapid injection of the solution.

The diluted pentothal sodium can be kept in solution for several days thus eliminating unwanted waste.

When anesthesia is induced with a 0.4 per cent solution, the fluid is allowed to flow in a steady stream or to drip rapidly. The patient is allowed to count out loud and ordinarily will be asleep in from 45 to 75 seconds. As soon as the desired depth of anesthesia is reached the rate of flow is reduced. Clotting in the needle is prevented by this method and easy controllability is an added advantage.

The 0.3 and the 0.1 per cent dilutions of the pentothal sodium are used in conjunction with local and spinal anesthetics and have special value for an apprehensive patient who wishes to be asleep. The use of these dilutions is entirely sedative and the anesthesia is dependent upon the local or spinal anesthetic agents. It has been found that these dilutions give greater relief of nausea and vomiting than 100 per cent oxygen when spinal anesthesia is used.

MARY KARP, M.D.

McCann, J. C.: Anesthesia by Combined Intravenous Pentothal Sodium and Local Nerve Block. *J. Exp. Med.* 1945 233 55

The combination of intravenous administration of pentothal sodium and regional nerve block has become the anesthesia of choice for major as well as minor surgical operations, with few exceptions at St. Vincent's Hospital, Worcester, Massachusetts. The exceptions are (1) operations in children under seven or eight years of age, because of the small caliber of the veins (2) operations about the neck in the absence of intratracheal intubation, because of the too easy stimulation of reflex laryngospasm (3) operations on patients over sixty years of age who are to undergo a prolonged operative procedure because of the unsatisfactory metabolic destruction of large doses of the drug and the danger of pulmonary edema from prolonged depression and (4) operations on patients with vomiting, asthma or abdominal distention.

During the past year the author employed pentothal sodium intravenously as the major anesthetic in 64 per cent of approximately 800 surgical cases of all types.

Frequently pentothal sodium (intravenous) as the sole anesthetic does not provide adequate muscular relaxation without the danger of respiratory depression, and surgeons have employed various combinations. Small amounts of ether and cyclopropane quickly and completely make up for these deficiencies.

of the pentothal sodium. Although some surgeons report that nitrous oxide and oxygen afford additional help, the author believes that the results are not comparable to those procured by the complementary use of regional nerve block. Only 3 to 4 per cent of his cases required ether or cyclopropane as supplemental anesthesia.

In this series pentothal sodium was administered as a 1 per cent solution by the continuous-drip method, which has been well described in the literature. In the infrequent cases in which the veins were so small as to cause an unsatisfactory rate of flow a 2 per cent solution was used. After induction, the drug was administered during the period of maintenance in repeated and grouped subminimally in amounts of either 5 c.c. or 10 c.c. according to the rate of metabolic destruction of the drug in the given case. Between each subminimal fraction there was a wait of one minute to observe the effect on the respiratory center. The drug was given with the usual intravenous-infusion apparatus and the drops were regulated through a Murphy drip to about 250 per minute for induction and between 150 and 240 per minute for maintenance. A companion infusion apparatus provided for continuous administration of saline or glucose solution during the intervals between the pentothal-sodium fractions and for the instantaneous administration of plasma or blood without disturbance of the patient during the operation. The intervals between fractions were from five to fifteen minutes. Having observed the syringe technique for several years, the author adopted this method as the simplest, most dependable and most flexible way of administering pentothal sodium.

Local anesthesia by means of 1 per cent novocain was used to take up the deficiencies of the pentothal sodium. Patterns of blocking the sympathetic or intercostal nerves according to the type of operation were mapped out from the background of general experience with regional anesthesia.

This complementary use of the two agents provided a completely satisfactory anesthesia comparable in all respects and superior in many to spinal or deep general anesthesia. It was accomplished with the administration of only moderate doses of pentothal sodium. If the two methods are effectively combined the result provides a speedy safe type of anesthesia, with an induction and recovery experience strikingly free of unpleasant and uncomfortable episodes such as are associated with the other principal anesthetic methods. Nausea and vomiting are infrequent postoperative catheterization of male patients is rarely necessary and in cases of hemorrhaphy has practically disappeared postoperative headache does not occur the administration of parenteral fluid except as required by the technical exigencies of the operation is reduced almost to the vanishing point and early ambulation is favored.

The author believes the combination of intravenous administration of pentothal sodium and anterior splanchnic block constitutes an ideal anesthetic for all operations on the stomach, spleen, gall bladder and ducts. The combination has been particularly popular on the European continent, and no anesthetic fatalities had been reported up to 1937. In the author's cases the use of anterior splanchnic block resulted in a reduction of about 1 gm. in the average total dosage of pentothal sodium required.

The purpose of anterior splanchnic block is to deposit an anesthetic dose of novocain retroperitoneally at the level of the first and second lumbar vertebrae between the aorta and the inferior vena cava. This is an isthmus point or meeting place for all sympathetic nerves and plexuses deriving from the greater and lesser splanchnic nerves and the sympathetic trunks which supply the stomach, duodenum, pancreas and transverse colon.

The author presents a modified technique that he devised for carrying the splanchnic needle to assured and safe contact with the first lumbar vertebra.

Douglas R. Morton, M.D.

PHYSICOCHEMICAL METHODS IN SURGERY

ROENTGENOLOGY

Peake, J. D.: Radiation Therapy in Uterine Fibroids. *Semin. M. J.* 1945 38 480

The author reports on 390 cases of uterine fibroids treated by radiation therapy and followed up from six months to ten years. All the patients had symptoms usually abnormal uterine bleeding and especially menorrhagia. Their average age was forty-two years and the ages ranged from twenty-six to seventy-seven years. The diagnosis was based on the history and pelvic examination by at least two physicians; some patients received preliminary diagnostic curettage. Patients with complicated pelvic conditions, those in whom the diagnosis was doubtful and those with very large tumors were not treated by this method but were referred for surgery. On the other hand for patients with some concurrent illness contraindicating surgery, such as coronary heart disease, radiation was considered the treatment of choice for fibroids with bleeding.

Roentgen therapy alone was given to 186 of the patients, with from 350 to 300 roentgens measured in air given daily through one of the two or three pelvic portals 15 cm. in diameter until from 6 to 12 treatments had been given within two weeks. The factors were 200 kv.p., 30 ma., 50 cm. distance, a filter of 6 mm. of aluminum plus 0.5 mm. of copper of high value layer o.p. The larger doses proved the more successful.

Eighty-six cases had only radium, inserted after dilatation and curettage from 35 to 50 mgm. with 1 mm. of platinum filter being left in the uterine cavity until a total dose of from 800 to 3,000 mgm. hrs. was reached. In addition, 18 cases which had not responded well to a course of roentgen therapy were given radium in smaller doses.

In all but 3 cases bleeding stopped in from six weeks to three months. No menopausal symptoms occurred before the third month, but thereafter two-thirds of the patients developed hot flashes, increased nervousness or headache. Treatment consisted of barbiturates, estrogens, and reassurance. In 2 cases bleeding recurred after the use of stilbestrol, and in 1 case after theelin, but it stopped when the drug was discontinued. No patient gave a history of loss of libido following irradiation and no pregnancies occurred, but several of the younger patients eventually re-established a normal menstrual cycle.

The author concludes that uterine fibroids respond well to irradiation therapy as indicated by the arrest of bleeding and reduction in size of the tumor that complications are slight, and that irradiation is the method of choice for patients with concurrent disease rendering surgery dangerous.

LILLIAN DONALDSON M.D.

MISCELLANEOUS

Hooper H.A., and Dean, C.A.: Studies in Hodgkin's Syndrome. The Therapeutic Use of Radioactive Phosphorus. *J. Lab. Clin. M.* 1945, 30 678.

The authors report the treatment of 11 patients with histologically proved Hodgkin's disease by bi-weekly intravenous, and occasionally oral administrations of radioactive phosphorus (P^{32}). The single doses ranged from 1 to 3 or m.c. of intravenous equivalent. Therapy was discontinued as soon as an increase in the activity of the disease or bone involvement, became evident and this occurred in 10 of the patients. (One patient died during treatment and another patient failed to return for further treatment.) The maximum and minimum periods during which treatment occurred, before additional evidence of disease activity developed were thirty-seven weeks and ten weeks, respectively.

The conclusion was reached that radioactive phosphorus was not of therapeutic value and that successful subsequent x-ray treatments in 8 of the patients indicated the superiority of the latter method. The treatments affected the blood in a similar manner as did treatments with roentgen rays, e.g., all cases showed a drop in the leucocyte count. Of interest was the intense depression of the platelet count in 7 of the cases, which persisted even after the administration of P^{32} had been discontinued. No clinical evidence of hemorrhage occurred.

The authors discuss briefly the preparation of the radioactive phosphorus isotope (P^{32}) by bombardment of regular phosphorus with a ten million volt deuteron beam in the Ohio State University cyclotron.

OSCAR D. SCHWARTZ, M.D.

Clarkson, J.R., Bong, J.W., Holmes, B., and Ellis, F.: Symposium: Physical, Biochemical, and Therapeutic Aspects of Volume Dose. *Brit. J. Radiol.* 1945 18 233, 35 38, 240.

In 1935, it occurred to Ellis that a certain advantage may be derived from a knowledge of the total quantity of energy of radiation absorbed by the body during the course of treatment. This he called the "volume dose." In 1940 Mayneord carried out a series of experimental investigations to determine the magnitude of this dose. As a basic unit he suggested the gram-roentgen, which is the energy conversion when 1 roentgen is delivered to 1 gm. of air and is approximately equal to 85 ergs. A megagram-roentgen (one million gram-roentgens) is approximately equivalent to a calorie.

In the present symposium Clarkson discusses the physical aspects of the volume dose. He pays attention to the value of the dose (1) during whole-body irradiation, and (2) during limited field irradiation.

1. A wax model patient of elliptical cross-section, and divided into slabs has been constructed (in con-

junction with Mayneord) By placing condenser ionization chambers in some of these slabs and by making use of a focal skin distance of 250 cm. so that the entire body is irradiated at one time measurements have been made for various situations. The volume dose was then calculated from the doses recorded by the ionization chambers. It was found that for equal surface doses the volume dose varied greatly with the quality of the radiation. This is important in devising protection regulations against stray radiation. It appears that a person working in a "deep therapy" department may absorb five times as much energy for an equal measured stray radiation dose as one engaged in diagnostic work.

2. No systematic measurements were carried out with the limited fields of irradiation. One condition studied, however led to two interesting results (a) it was found that a large proportion of the energy absorption (about 30 per cent in the particular case) occurred in parts of the body receiving less than 10 per cent of the dose at the center of the field on the surface and (b) it was also found that if a limiting diaphragm of 3 mm thickness of lead was used (with roentgen rays of 3.7 mm copper half value layer) the total energy absorption was almost 50 per cent greater than when one of 11 mm. thickness was used which means that the common limiting diaphragms are not thick enough.

Mayneord recently supplied graphs and tables which make it possible to calculate the volume dose for various methods used in roentgen and radium therapy. In radium therapy the volume dose is expressed in gram-roentgens per milligram hour.

Boag discusses the energy absorbed by a patient during x ray treatment. He gives physical data which are complementary to those of Clarkson, in that they refer entirely to limited fields. They have been obtained from measurements carried out (in conjunction with Walter) on the celluloid model patient devised by Grimmer (1939-1942) for this purpose. This model is constructed of graphited cellulose acetate plates, 6 mm. thick, spaced apart by 2 mm thick washers of the same material. The graphite makes the plates electrically conductive. Alternate plates are connected together and the two groups of plates thus formed are connected to opposite poles of a battery. A sensitive galvanometer included in the circuit measures the total ionization current collected from all the air gaps where there are in a radiation field. Certain requirements must be fulfilled if the measurements made with such a model are to give a true picture of the energy absorption in the human body. These are briefly described.

The following situations have been studied: field on pelvis, field on chest, short focal skin distance, head fields, dependence on half value layer, mass of fields, effect of size of the patient and the distribution of absorption in different parts of the body. The investigations were carried out with roentgen rays of 2 to 4 mm. copper, half value layer and the curves so obtained plotted. The conclusion was that the volume dose depends upon the area and site of the

field and to a much smaller extent upon focal skin distance, linear dimensions of the patient and half value layer of radiation.

Holmes discusses the biochemical aspects of volume dose. The author states that none of her observations were made with consideration of the volume dose but that in few cases enough data are available to allow of calculation.

It is not possible to draw positive conclusions although there remain some clear suggestions for future work.

It is inevitable that investigations of general biochemical effects should be related to x ray sickness. A great deal of work has been done on this. Among the various phases studied are: acidosis, alkalosis, changes in the calcium, sodium and potassium concentrations of blood tissues and urine, changes in the blood cholesterol, liberation of histamine, the role of cortical hormone and, more recently, the responsibility of purines. It is interesting in connection with the purines that uric acid, the end product of purine metabolism, is found in increasing amounts in animal tumor cells twenty-four hours after irradiation.

Ellis discusses the clinical aspect of the volume dose in radiotherapy. He calls attention to the fact that the term mega gram roentgen because it assumes unit density of the patient might be better replaced by a volume unit. However no such neat term is available since the analogous "volume" term would have to be mega cubic centimeter.

Unlike Mayneord's wax patient and Grimmer's celluloid patient, human beings are complex physico-chemical systems subject to mental and a multitude of other influences. Because of this biological phenomena are difficult to correlate with volume dosage.

The relationship of volume dose and tumor dose can be changed by varying (1) the field size (2) the focus-skin distance (3) the quality of the beam and (4) the arrangement of the number of fields.

1. The effect of field size. The volume dose is calculated by the formula

$$D \times A \times \frac{\text{max. r./min. possible}}{\text{r./min. for field size considered}}$$

where D is read from a graph (of Hapsey) and A = area. It results from this formula that other things being equal the volume dose is almost proportional to the field area. For example if the field is 400 cm² and the beam passes through 20 cm. of tissue, the volume dose is 13 x 400 x $\frac{1}{20}$ x dose and for a field of 50 cm² it is 13 x 50 x $\frac{1}{20}$ x dose. The ratio of the volume doses therefore is $\frac{400}{50} \times \frac{1}{21}$ for the same surface dose. For the same depth dose the ratio becomes more nearly equal to that of the areas. A circular field of 10 cm. in diameter will give a less volume dose than a square field of 10 cm. side.

2. The effect of the focus-skin distance. Other things being equal the greater the focus-skin distance the smaller the volume dose and thus the less the untoward general reaction.

3. The effect of the quality of the beam. This has been demonstrated by Phillips when he treated car-

carcinoma of the rectum with 6,000 roentgens by using in one case 200 kv. and in the other 1,000 kv. The volume dose was much greater with the high voltage beam for the same surface dose other things being equal.

4. The arrangement and number of fields. Ungar in 1933 analyzed the factors in this respect. He gives examples of arrangements of fields for carcinoma of the cervix in relation to "economy quotient and volume dose. The economy quotient is defined as the ratio of the minimum tumor dose divided by the difference between the maximum and minimum tumor doses. It was found that other things being equal the arrangement which gave the greater economy quotient gave the smaller volume dose.

In correlating the biological phenomena with the volume dose, special attention must be paid to the general or constitutional as distinct from local phenomena. They may be divided into subjective and objective. The former include malaise, nausea, vomiting, headache, etc., which it is impossible to measure or dissociate from the effects of local phenomena. The latter are divisible into two classes (1) blood counts and (2) other measurements.

1. Bush, in 1933, published a curve correlating the volume dose with the proportional decrease in lymphocytic count relative to the initial count. The author himself found so much variability and his experience with other features of the blood count were even less encouraging.

2. Other measurable quantities are the corpuscular volume, color index, sedimentation test and blood pressure. None of these varies as readily as does the number of lymphocytes with the volume dose.

As a whole the conclusion is drawn that the chief value of the volume dose at present is in evaluating

principles of treatment and protection on physical grounds rather than being a practical guide to biological effects.

T. LARCOMA, M.D.

Camp, J. D., and Moreton, R. D.: Radiation Necrosis of the Calvarium (Report of 5 Cases). *Radiology* 1945 45 13.

The authors found 5 cases of radiation necrosis of the calvarium in a series of 2,036 cases of intracranial tumors which were treated by roentgen rays and with or without surgical measures at the Mayo Clinic. However, since no systematic follow-up roentgenograms were available in all cases it is probable that the incidence was higher.

The 5 cases are presented in detail and illustrated with their respective roentgenograms. In the first case the radiation necrosis was discovered five years after the roentgen therapy. In the second case 1 year later, in the third case 12 years later, in the fourth case 14 years later and in the fifth case 17 years later.

In none of these patients was there any symptoms referable to the necrosis of the bone. Because of this and since the calvarium does not function as a structure of stress the authors believe that no attempt should be made to reduce the roentgen dose which is necessary to destroy the intracranial tumor for which the treatment is originally undertaken. The long survival obtained in the cited cases well justifies the soundness of the technique of irradiation employed.

The knowledge of the possibility of necrosis of the calvarium following intensive roentgen irradiation of the skull is important for the reason that it may obviate confusion in the diagnosis with other similar conditions.

T. LARCOMA, M.D.

MISCELLANEOUS

CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Carter S. J.: Serum Amylase Findings in Chronic Alcoholic Patients with Acute Severe Abdominal Symptoms. *Ann Surg* 1945 122 117

The purpose of this article is to emphasize the significance of the high serum amylase values found in a group of 11 patients suffering from acute abdominal symptoms in whom there was a history of chronic alcoholism. The symptoms and signs upon admission of these patients were vomiting severe epigastric pain and marked upper abdominal rigidity with or without epigastric tenderness. In this type of patient, the diagnosis of acute alcoholic gastritis is usually made while occasionally an unnecessary exploratory laparotomy is done for a possible surgical lesion. The preceding alcoholic debauch evidently precipitates changes in a digestive system that has been impaired by the prolonged excessive use of alcohol.

Four of the 11 patients in this series were subjected to operation and in each instance edema about the pancreas was noted. The peritoneal fluid was of a thin sanguineous character. In the remaining 7 patients the high amylase levels were the chief factor in deciding against operative intervention. These 7 patients were discharged well.

The cause of the elevated serum amylase is considered to be the rapid destruction of the acinar membranes of the pancreas and the sudden escape of the enzyme into the blood stream. Evidence concerning relationships between the ingestion of large amounts of alcohol, chronic alcoholic gastritis and pathological changes in the pancreas is discussed.

JOHN L. LINDBQVIST, M.D.

Herbut, P. A., and Scarsdale, T. M.: Diffuse Hepatic Necrosis Caused by Sulfadiazine. *Arch Pathol, Chic.* 1945 40 94

A review of the literature discloses reports on 4 cases of acute diffuse hepatic necrosis resulting from the use of sulfanilamide. To these the authors added 2 cases of this condition following the administration of sulfadiazine. One patient had not previously received sulfonamide compounds whereas the other had been given a course of treatment with sulfadiazine one month before a second course was administered.

It is thought that while focal hepatic necrosis may result from outright chemical action of the sulfonamide compounds on the liver cells, diffuse hepatic necrosis may be the result of inherent or acquired hypersensitivity of the liver for the drug.

Of the two types of renal damage ascribed to the sulfonamide compounds the authors believe that the one type wherein crystals or concretions are found in and beyond the renal tubules is due to the direct

action of the sulfonamide compounds on the kidney. The more severe type, however, showing tubular necrosis casts and interstitial congestion and edema with foci of inflammatory cells is due, they believe to the accompanying disease process which may be infection, intestinal obstruction, jaundice, or some other condition, and not to direct action of the drug on the renal parenchyma. EARL O. LATIMER, M.D.

Rosenberg, A., Jr., and Welch, H.: A Study of the Types of Hypersensitivity Induced by Penicillin. *Am J Hyg* 1945 51 138

The authors state that a study was made to determine the incidence of hypersensitivity of the tuberculin type to crystalline penicillin sodium in individuals who had had no previous contact with this drug. Studies were made also of the sensitivity induced by the injection of commercial or crystalline penicillin sodium. The procedure which was followed is given in detail.

To determine the incidence of the tuberculin type of sensitivity to penicillin 644 persons were tested. Each person was injected intradermally on the volar surface of the forearm with 0.1 c.c. of penicillin sodium containing 1,000 units. When a positive reaction resulted a retest was made with crystalline penicillin. Eight individuals exhibited hypersensitivity of the tuberculin type when tested initially. Attempts to show a passive transfer of the hypersensitivity with use of the Prausnitz-Kustner technique and the Urbach-Koenigstein method both failed.

The authors state that it has been previously noted that following intradermal injections of commercial penicillin in man there developed a flaring phenomenon in certain persons which appeared only after a variable number of injections had been made. This phenomenon consisted of an increase in redness and itching at the sites of former injections following the intradermal injection of crystalline penicillin sodium in the new site. Persons who exhibited this type of reaction failed to do so after a rest period during which no injections were made. The authors injected 9 individuals intradermally with 1,000 units of commercial penicillin sodium, 1,000 units in 0.5 c.c. of saline solution at each of 10 different sites. These injections were repeated in approximately the same areas five and ten days later, a total of thirty injections being given. Following the first series of 10 injections some of the subjects showed evidence of chemical irritation, all who showed the irritation developed it from the same lots of penicillin. Following the second series of 10 injections reactions occurred in 3 people. One individual who had previously received injections showed the flaring phenomenon described, at the site of the old injections. Another developed urticaria thirty hours after injection. Two days after the reaction had subsided

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an attempt was made to transfer the sensitivity of the latter to 3 normal individuals by the Prausnitz-Kustner technique. Passive transfer was not successful. In the third series of 10 injections the reaction varied considerably. Four subjects showed erythema around all injected sites within from fifteen to thirty minutes. Wheals, varying in size from 5 to 15 mm., developed in 2 of these individuals and subsided within a period of from one to two hours. The other 4 test subjects showed, in addition to whealing and marked erythema at the sites of injection, the flaring reaction at the old sites of injection. One of the group of 4 exhibited the most intense reactions.

The authors attempted to induce sensitivity by varying the technique of administration. Only 1 person developed an increase in sensitivity and this individual was one of those who had been injected intradermally with crystalline penicillin sodium. Because of the reactions shown, a series of patch tests was made to determine whether the eczematous type of hypersensitivity could be demonstrated. The tests were made with commercial penicillin sodium. Although all patch tests were negative intradermal tests made at the same time with crystalline penicillin sodium again revealed a positive tuberculin type of sensitivity to crystalline penicillin sodium and also gave a positive reaction at the site of a previous intradermal injection of either commercial or crystalline material.

After the skin of 5 other people was sand-papered sufficiently to cause a faint pin-point punctum of blood, patch tests were made. These were negative, and indicated that the negative patch tests resulted from the lack of a hypersensitive shock tissue rather than from inability of penicillin to penetrate the horny layer.

An attempt was made therefore to transfer passively the hypersensitivity exhibited by individuals in whom the hypersensitive state had been induced by intradermal injection. Passive transfer antibodies could not be demonstrated. Precipitin tests made on the serum of the 4 test subjects were also negative.

To determine whether the sensitivity to penicillin would also extend to the spores of penicillin notatum, a heat killed suspension was made containing 50,000 spores per cubic centimeter. Intradermal injections of 0.1 c.c. were given to 5 persons who exhibited a tuberculin type of hypersensitivity to penicillin. There were no immediate or delayed reactions.

In conclusion, the authors state that 5 per cent of 144 individuals tested with crystalline penicillin sodium exhibited a positive reaction of the tuberculin type despite the fact that none of these individuals had any prior contact with penicillin. Repeated multiple intradermal injections of penicillin sodium caused the development in some people, of reactions of the Arthus type, and some of these also developed a tuberculin type of hypersensitivity.

Since the material at test strength is not a primary irritant a positive reaction indicates that these in-

dividuals are specifically hypersensitive to this material. It is assumed that these individuals have had previous contact with penicillin sodium or with an immunologically equivalent material. Contact with penicillin sodium as such can be arbitrarily eliminated. However contact with penicillin appears to be quite likely since it is a fairly common genus of fungi. It may be ingested or inhaled and, in susceptible individuals produces a subclinical infection with a consequent alteration in their immunological responses.

HAROLD F. THURGOOD, M.D.

Hines, L. E., and Kessler, D. L.: The Effect of Penicillin on Heparin Tolerance. *J Am M Ass* 945: 1870-4.

Studies of the effect of penicillin on heparin tolerance were carried out following the occurrence of extensive visceral hemorrhages in 2 patients with bacterial endocarditis who were treated by penicillin.

The first case was that of a female 37 years of age. Serial blood cultures showed hemolytic streptococci. During the period between May 27 and June 8, 1944 this patient had received 700,000 units of penicillin intramuscularly. Two days following the first injection her temperature was found to be normal and spectacular symptomatic improvement was shown. However in 25 days following her admission to the hospital she suddenly developed generalized tonic and clonic convulsions which lasted for a period of 2 hours she became comatose and died 3 days later. At autopsy the anatomic findings were extensive spontaneous subarachnoid hemorrhage of the base of the brain secondary to a large hemorrhage of the pons, almost healed endocarditis to the mitral valve (hemolytic streptococci, clinical) small recent infarct of the left lung, ancient infarct of the spleen and cystitis of the urinary bladder.

The second case was that of a female 23 years of age who had been pregnant for a period of 5 months. Serial blood cultures were negative after 21 days and the patient delivered a viable baby in the seventh month of pregnancy. During the next 12 days 1,000,000 units of penicillin were given intramuscularly and in addition, 100 mgm. of heparin were given during the first 5 days. The patient's temperature gradually subsided to normal after a period of 7 days. Death occurred 13 days following delivery. At autopsy the anatomic findings were as follows: vegetative and ulcerative endocarditis of the aortic and tricuspid valves with erosion and perforation of both valves, acute perforated ulcer of the stomach with extensive hemorrhage into both the lesser and greater peritoneal cavities, extensive petechial hemorrhages of the peritoneum, pericardium, pleurae and serosa of the small intestine and other minor findings. The greater peritoneal cavity contained air and more than 1 liter of partially clotted blood.

The 2 patients presented the following points of similarity: proved bacterial endocarditis early improvement by penicillin therapy and fatal termination from hemorrhage 1 by extensive cerebral hemorrhage the other by widespread, intraperitoneal

mesenteric and pleural hemorrhages. One patient received heparin while the other did not.

Studies were made on the effect of penicillin on the clotting mechanism, and particularly the effect of penicillin on the reaction of the blood to heparin.

Other studies were made on a series of patients before penicillin was administered, during the course of therapy and after the penicillin had been discontinued. These studies included erythrocyte counts, hemoglobin determinations, prothrombin time, platelet counts and heparin tolerance curves. In each case the penicillin was administered intramuscularly in doses of 10,000 Oxford units every 3 hours. One-half of the patients studied had diseases which were considered unsuitable for penicillin therapy and therefore served as controls.

Although in the 10 cases studied there were no significant changes in the erythrocyte count, hemoglobin, platelet count or prothrombin time, a definite change was produced in some patients in the heparin tolerance curve. In 2 patients very profound effects were registered in their sensitivity to heparin. There was no effect on the tolerance curve in 3 patients; there was a slight but inconclusive increase in 5 patients.

These studies suggest that it is advisable to run heparin tolerance sensitivity tests as a precautionary measure if heparin and penicillin are to be used at the same time. RICHARD J. BENNETT, JR., M.D.

Marriott H. L. Medical Problems of the South East Asia Command. *Lancet* Lond. 1945 248 679

The biggest single lesson learned from the experience of the last three years has been the tremendous importance of disease in wasting manpower. No figures of value are available for 1942. In 1943 the admission rate to hospitals and other medical units was just under 1,200 per 1,000 per annum. In 1944 it was just under 1,000 per 1,000 (this is equivalent to every man in the force being admitted to the hospital in the course of a year). Disease has played an enormously greater part in man-power wastage than has enemy action. The ratio of casualties from sickness to casualties from wounds in 1943 was 122:1 and in 1944 a year of heavy fighting it was 19:1.

At least four fifths of the sickness casualties have been due to diseases which may be classified as preventable. This being the case it would seem rational to employ a very much higher percentage of personnel in the business of prevention. Any men given to the hygiene units by the hospitals and other curative units do not represent a loss to the last two units because the diminished incidence of disease will result in much less work for them. One medical officer engaged in hygiene can save the work of 10 medical officers in hospitals.

After disease prevention the most important function of the medical services is the rapid cure and return to duty of all sick and wounded. In this respect the value of diagnosis and treatment at the earliest possible moment cannot be overstated. The

diseases particularly malaria, diarrhea, the dysenteries and skin diseases have in common that their response to treatment is proportional to the speed with which it is applied. What is done at once matters much more than what may be done several days later.

A compressed review such as this does not lend itself to summarizing. The author hopes that its brevity relative to the extent of its subject may excuse a tendency to dogmatism and perhaps to oversimplification. JOHN E. KIRKPATRICK, M.D.

Welch C. S., and Tuhy J. E.: Combined Injuries of the Thorax and Abdomen. *Ann Surg* 1945 122 358.

Welch and Tuhy discuss their experiences in the definitive treatment of 83 patients with combined injuries of the thorax and abdomen treated in an evacuation hospital. There were 4 principal types.

Thoracoabdominal wounds—those in which a missile enters the pleural cavity first traverses the diaphragm and lodges in or traverses the peritoneal cavity. These made up the largest group (53 cases).

Abdominothoracic wounds—those with primary involvement of the abdomen followed by perforation of the diaphragm and injury to the thoracic cavity. The 13 cases in this group were placed in a separate category because of the somewhat different problems and prognoses which they presented.

Thoracodropenitoneal wounds—those involving the diaphragm and retroperitoneal structures (commonly the kidney) without apparent involvement of the peritoneal cavity. The 6 cases under this heading are grouped together as the order in which these structures were injured seemed to make little difference in the outcome.

Thoracic and abdominal injuries—these include (1) separate missile wounds of both cavities 7 cases, (2) a subcutaneous injury to the chest and abdomen by blunt trauma 2 cases and (3) missile wounds of one body cavity associated with blunt injury to organs of the other 2 cases with penetrating chest wounds associated with contusion of the kidney in 1 instance and of the spleen in the other belong in the last category.

The wounds were on the right side in 48 cases with 8 deaths and on the left side in 33 cases with 12 deaths. Both patients in whom the chest was involved on one side and the abdomen on the other died. The operability rate was 88 per cent. Half of the patients had associated injuries.

Five principal types of operation were carried out: (1) thoracotomy and transdiaphragmatic operation, (2) thoracotomy and transdiaphragmatic operation combined with celiotomy, (3) celiotomy alone, (4) repair of the kidney and (5) wound exploration with suture of the pleura if necessary.

Five of the 40 patients with injury on the right side and 7 of the 30 with injury on the left side all of which were operated upon died during the period of observation. The operative mortality rate was 17 per cent. STEPHEN A. ZIEGLER, M.D.

Snyder H. E.: The Management of Intrathoracic and Thoracoabdominal Wounds in the Combat Zone. *Ann Surg* 1945 33 333

Snyder thinks that few casualties with wounds of the chest who survive to be evacuated from the battle field would die if properly equipped trained surgeons were available for their care and first priority management, consisting of prompt care and surgery in the most forward hospital installations were provided.

A surgeon familiar with both thoracic and abdominal surgery is best qualified to treat severe wounds of the chest which are encountered in the most forward hospitals and an anesthetist well trained in endotracheal anesthesia for thoracic surgery is essential. Oxygen-ether administered endotracheally through a closed apparatus capable of positive pressure is the preferred anesthetic in all perforating and penetrating wounds of the chest whereas prompt well-directed resuscitative measures, plus thoracotomy are required for the recovery of patients with thoracoabdominal wounds with continuing intrathoracic hemorrhage and large bronchial fistulas.

The preferred management of open chest wounds consists in the proper occlusion with gauze and adhesive strapping until the patient is in a hospital equipped and staffed to do intrathoracic surgery.

Early and repeated aspiration of hemothoraces, without air replacement, is recommended, and hemorrhage has not recurred because of this practice. Moreover it is believed that early aspiration of large pneumothoraces and continuous aspiration by catheter water-seal drainage of pressure pneumothoraces must be accomplished to secure a high survival rate in such conditions.

Intercostal nerve block, to relieve pain, to promote deeper breathing, and to facilitate expulsion through the coughing up of blood and mucus in the tracheobronchial tree, is an important adjunct to therapy whereas tracheal catheter suction has an important place in the pre- and postoperative management of chest wounds.

At the termination of every operation upon a patient with a chest wound, a bronchoscopic aspiration of blood and mucus from the trachea, main stem bronchi and lobar bronchi should be done. It may be indicated in the preoperative, operative and postoperative periods when less radical measures fail to clear the tracheobronchial tree.

Replacement therapy particularly with whole blood, is most important, and autotransfusion of pleural blood should be used whenever practicable. Care must be exercised to give the blood slowly after the systolic blood pressure has reached 80 mm Hg. and to give no more blood than is necessary to attain adequate resuscitation.

Most wounds of the chest need only débridement of the chest wall, preceded and followed by proper chest management replacement therapy and oxygen therapy. There are certain indications for thoracotomy through the wound, and fewer indications for formal thoracotomy by separate incision.

Surgery of chest wounds with few exceptions should be done first in the case of multiple wounds, thoracoabdominal wounds and combined intrathoracic and abdominal wounds. Most thoracoabdominal wounds are best handled first by the thoracic approach a celiotomy being performed only if abdominal wounds cannot be cared for by the transdiaphragmatic route.

Evacuation from the pleura of blood, air and all foreign bodies and irrigation of the pleura with physiological salt solution is desirable in the surgery of perforating and penetrating wounds of the chest. On the other hand, complete expansion of the lung by its inflation to the chest wall and evacuation of all pleural fluid and air should be effected at the end of all operations in which the pleura is opened.

Sulfonamide or penicillin therapy should be continued until the pleura is free of all air and fluid.

STEPHEN A. ZIEGLER, M.D.

GENERAL BACTERIAL, PROTOZOAN AND PARASITIC INFECTIONS

Saphir W.: Filariasis. *J Am Med Ass* 1945 33 114

The value of the old dictum that a diagnosis of infectious disease should not be made in the absence of the demonstration of the causative organism, is undisputed yet, if this dictum were adhered to the early diagnosis of filariasis could not be made in most cases. A delayed diagnosis until such a time as microfilariae become demonstrable might prevent the only effective procedure, namely early removal of the patient from the endemic area. Furthermore it would create a large reservoir of carriers on whom the mosquitoes could feed, and thus cause widespread propagation of the disease.

It is for this reason that a syndrome such as has been outlined must be depended upon, in order to reach at least a tentative diagnosis.

There seems little doubt that the clinical picture as described in the original article was due to filarial infection. It is true that the findings were not as typical as were those described in the textbooks nor were there typical filarial attacks accompanied by constitutional symptoms such as fever, general malaise and prostration. On the other hand, there was a history of exposure to day and night biting mosquitoes in an area where the native population was known to be heavily infected with filariasis. There was a more or less generalized lymphadenopathy and various types of genital lesions were present. Periodic aggravations of palms and swellings so characteristic of the later stages of the disease were commonly observed. However the asymptomatic stage also peculiar to late cases was not noted in this series. Nocturnal pains and particularly nocturnal orchidodynia, were frequent complaints.

Laboratory tests as performed were of little diagnostic help, with the possible exception of the test for eosinophilia which was present in 40 per cent of the cases. The diagnosis must be based on clinical evidence.

DOUGLAS R. MONTGOMERY, M.D.

Weich H. Price, C. W. and Chandler V. L.: Oral Penicillin. *J Am Med Ass* 1945 138 845

The successful oral administration of penicillin may depend upon complete neutralization of the acidity of the stomach plus a relatively slow release of the drug from some chemical which adsorbs it readily. Thirty cubic centimeters of aluminum hydroxide gel (U.S.P.) were added to 100,000 units of penicillin dissolved in water. 30 c.c. of magnesium magna (U.S.P.) were added with constant agitation to 100,000 units of penicillin dissolved in water. The penicillin and metallic hydroxides were centrifuged at high speed, and it was found that approximately 50 per cent of the penicillin which had been added to the aluminum hydroxide remained adsorbed on the sediment. In the case of magnesium hydroxide approximately 25 per cent of the penicillin remained adsorbed on the sediment. The metallic hydroxide sediments were washed several times with distilled water. Approximately 50 per cent of the original amount adsorbed still remained. It appears that penicillin adsorbs more readily by aluminum hydroxide than by magnesium hydroxide but that magnesium hydroxide is more retentive.

Oral administration of penicillin treated with aluminum hydroxide was carried out. These tests were carried out with the use of 100,000 units of penicillin sodium in 20 c.c. of water and 30 c.c. of aluminum hydroxide (U.S.P.). Bloods were taken at stated intervals following ingestion. Control tests were carried out with the use of 100,000 units of untreated penicillin sodium. With the aluminum hydroxide, about 50 per cent of the blood samples at twenty-four hours showed a concentration of penicillin equivalent to from 0.03 to 0.045 unit per cubic centimeter of serum. In the control test with the untreated penicillin sodium, no penicillin could be demonstrated in the blood samples collected at the seventh and the twenty-fourth hour.

Other tests were carried out whereby instead of giving one initial large dose the same amount of penicillin was given in four full and equal doses of 25,000 units each at two-hour intervals. With this method the concentration of penicillin in the blood did not drop below approximately 0.08 units per cubic centimeter until after the eighth hour. From the eighth until the twelfth hours a concentration of 0.06 units or more per cubic centimeter was maintained. Between the twelfth and the fifteenth hours the concentration dropped to 0.036 unit per cubic centimeter and this level was maintained through the twenty-eighth hour.

By contrast 6 persons given 100,000 units of untreated penicillin sodium in 25,000 unit doses every two hours had an assayable level for from seven to eleven hours. With the use of magnesium hydroxide in similar tests the results were similar to those obtained with penicillin modified with aluminum hydroxide. The amount of magnesium hydroxide used caused some laxative effect in 60 per cent of the persons using it. Magnesium hydroxide nevertheless was as effective as aluminum hydroxide in the

maintenance of penicillin in the blood after administration. 72 per cent of penicillin was excreted in the urine over a period of twenty-four hours. After these metallic hydroxides and penicillin have been prepared and kept at refrigerator temperature both mixtures have been found to be stable for a period of at least thirty days. The strong neutralizing effect of aluminum hydroxide on the acid of the stomach is established.

There are indications which suggest that perhaps there is some absorption of penicillin directly from the stomach into the blood stream, and there is also some indication of an accumulative effect. When this penicillin aluminum hydroxide was given in fractional doses, the serial concentrations of penicillin did not fall below an effective therapeutic level until after the twenty-fourth hour and this is especially significant when it is considered that the penicillin aluminum hydroxide was not given until after the sixth hour. RICHARD J. BROWETT JR., M.D.

DUCTLESS GLANDS

Anderson T. and Trier M. Alternating Hyperthyroidism and Myxedema. *Acta med scand* 1944, 119 345

A case of alternating hyperthyroidism and myxedema in a woman who was 42 years of age on her first admission to the hospital in August 1935 is described. At this time she showed pronounced symptoms of exophthalmic goiter although her metabolism was normal. She was given iodine treatment and her metabolism fell to pathologically low values accompanied by the development of well marked symptoms of hypothyroidism. From that time up until March, 1941 she had 3 alternating periods of hypothyroidism and hyperthyroidism, decreased thyroid function developing when she was given iodine and increased function on thyroid medication. As the alternating changes in her condition became unbearable to the patient subtotal thyroidectomy was performed on March 12, 1941 after she had been given preoperative iodine treatment. After the operation she had hypothyroidism for the fourth time and was treated with thyroid gland tablets. After a transitory overdosage which resulted in symptoms of hyperthyroidism the thyroid treatment was discontinued in June 1943 and the patient has had no treatment since. In April 1944 her metabolism was still normal.

Apparently the normal condition of this patient was one of hypothyroidism in the course of which she developed a pathological condition of hyperthyroidism or dysthyroidism.

Zondek reported a similar case in 1943 in connection with which he held that conditions of hypofunction and hyperfunction of the thyroid gland must be caused by neurogenic or humoral factors outside of the gland and that the transition from exophthalmic goiter to myxedema is not due to temporary functional exhaustion of the thyroid.

AUDREY G. MORGAN M.D.

Muether R. O., Sexton, D. L., Macdonald, W. and Von Brueggen, J. T.: Clinical Experiences with Thiouracil. *Sark. M. J.*, 1945 38 443.

The authors present a review of the history of the development of thiouracil therapy and report an analysis of 35 cases. Each patient was thoroughly studied and all pertinent clinical laboratory studies were made. They find that thiouracil brings about a complete remission of symptoms in thyrotoxicosis. Available information indicates that it will accomplish all that surgery accomplishes in bringing about symptomatic relief. In Graves disease not previously treated with iodine, the effect is as quick and dramatic as the best results from iodine therapy, and in nodular toxic goiter improvement occurs in from four to eight weeks. In either condition the effect is lasting.

In recurrent hyperthyroidism thiouracil has brought about the relief of symptoms whereas iodine has failed.

Persistent symptoms following thyroidectomy with a normal basal metabolic rate may be relieved by suppression of the basal rate slightly below normal with thiouracil.

Thiouracil acts by inhibiting the formation of thyroxine, probably by direct action on the thyroid gland. In patients previously treated with iodine improvement is delayed.

As a preoperative measure, thiouracil is effective over a prolonged period, which makes it superior to iodine. Toxic effects of the drug may be serious. They can be minimized by cautious administration of the drug for the first few days and by limiting the dosage to 0.4 or to 0.6 gm. per day.

Thiouracil gives promise of leading to a medical cure of thyrotoxicosis and equals and, in many instances is an improvement over any previous form of therapy. Time may prove that it is of greatest value when used in conjunction with surgery. At this writing it cannot be said how long it will be necessary to continue the drug nor what unforeseen systemic effects may arise from its prolonged usage. Secondary systemic disturbances found in hyperthyroidism may be expected to show improvement as hyperthyroidism improves.

In several patients with nervous instability not associated with hyperthyroidism, suppression of the basal metabolic rate with thiouracil has had no effect on symptomatology. BENJAMIN GOLDMAN, M.D.

Hissell, G. W.: The Magnesium Partition in Hyperthyroidism with Special Reference to the Effect of Thiouracil. *Am. J. M. Sc.*, 1945 210 95.

Diffusible and nondiffusible serum magnesium fractions were determined in 24 hyperthyroid and 18 normal persons. In the thyrotoxic cases the nondiffusible fraction ranged between 3 per cent and 58 per cent of the total serum magnesium, with an average of 30.5 ± 1.9 per cent. In the normal persons the nondiffusible fraction varied from 17 to 43 per cent of the total, with an average of 30.4 ± 1.1 per cent. The author's data indicate the average total diffusible

and nondiffusible serum magnesium levels of hyperthyroid patients to be slightly lower than the comparative average values for normal individuals. However, the average value for the percentage of nondiffusible magnesium is almost identical in the two groups. The range of the percentage of bound magnesium in hyperthyroidism is strikingly varied, being just twice as great as the range for normal individuals.

Thiouracil apparently has no constant effect on the magnesium fractions in hyperthyroidism.

It is suggested that the variability in the magnesium fractions in thyrotoxicosis is the reflection of alterations in the metabolic processes.

BENJAMIN GOLDMAN, M.D.

Louis, P.: Nine Cases of Graves Disease Developed in Connection with Thyroid Gland Therapy. *Acta. med. scand.* 1945 83.

Histories are given of 9 cases in which exophthalmic goiter developed during or shortly after thyroid medication. In 7 of the cases the treatment had been given for simple obesity. The treatment had been continued for periods of from one month to several years. All of the 9 patients presented indications for subtotal thyroidectomy which was performed in 7 cases after preoperative iodine treatment. The results of operation were good. Two of the patients refused operation. Not only were the clinical features those of Graves disease, but histological examination showed the typical histological picture of this disease.

The conclusion to be drawn from these cases is that thyroid gland preparations should never be given for obesity. AUDREY G. MORROW, M.D.

Brown, E.: Exophthalmic Goiter Developing after Treatment with Thyroid Preparations. *Acta med. scand.* 1945 22 3.

In the Medical Out Patient Department of the Rugehospital in Copenhagen from January 1940 to September 1944, 15 patients were treated for thyrotoxicosis that developed after taking thyroid preparations. This constituted 3.2 per cent of the total of the patients with thyrotoxicosis treated during this time. In addition, the author had 3 similar cases in his private practice, a total of 18 cases. A table is given in the original article showing the clinical data in these cases. All of the patients were women, most of them in the climacteric age group. In 11 of the 18 cases the thyroid medication had been given for simple obesity. It was given for myxedema in only 3 cases.

The question arises as to why so few patients who take thyroid therapy develop thyrotoxicosis and the answer lies in the fact that a predisposition to thyrotoxicosis seems to exist in certain individuals. Such a predisposition has been demonstrated in 45 per cent of the patients in whom thyroid disease follows the administration of thyroid therapy.

Four of these patients showed a pronounced unilateral exophthalmos. This symptom was also re-

ported in 3 of the 28 cases of exophthalmic goiter following thyroid therapy that have been described in the literature previously. Therefore, if patients with thyrotoxicosis show marked unilateral exophthalmos they should be questioned carefully as to whether they have had thyroid medication.

It is estimated that in Denmark the amount of thyroid preparations consumed is 3 times as great as that required for the existing cases of myxedema. The greater part of this excess of thyroid is used by patients with obesity. Thyroid treatment should never be given for simple obesity and the public should be warned of its dangers.

AUGUST G. MORGAN, M.D.

Ljunggren E.: Surgical Treatment of Goiter Especially of Toxic Goiter (Hyperthyroidism) in Sweden. *Acta chir scand* 1944 89 346

Graphs are presented showing the increase in the number of thyroidectomies in the hospitals of Sweden from 1930 to 1942. This increase applies to both toxic and nontoxic cases. The number of operations for hyperthyroidism nearly tripled in this period being 536 in 1930 and 1,460 in 1942. The operative mortality decreased during this period from 4 to 2.3 per cent. During this same period the number of "medical deaths" from hyperthyroidism that is deaths without operation decreased about 50 per cent. The number of operations for nontoxic goiter more than doubled during this period 616 being performed in 1930 and 1,391 in 1942. During the whole period the mortality from this operation was less than 2 per cent and during the last 2 years it was only 0.2 per cent.

Results have been improved since the introduction of preoperative iodine treatment in 1935 and also by improved postoperative treatment with iodine, glucose, and vitamin B. Patients with hyperthyroidism are particularly sensitive to infection and if pulmonary infections can be prevented the patient's life can often be saved. Early operation is advisable in hyperthyroidism before the heart and other organs, particularly the liver have been damaged beyond repair.

AUGUST G. MORGAN, M.D.

SURGICAL PATHOLOGY AND DIAGNOSIS

Christensen A.: On Carotid Body Tumors. *Acta chir scand*, 1943 88 453

The anatomy, histology, and physiology of the carotid body are discussed and photomicrographs given of some typical tumors. The subjective symptoms of carotid tumor are slight as a rule. The most characteristic objective symptoms are the location of the tumor and its relation to the carotid arteries. Extirpation is the only radical treatment. Irradiation alone should not be given unless operation is contraindicated or impracticable as these tumors are generally radioresistant.

Some surgeons advise against operation in these tumors on account of the great risk, while others advise operation in spite of the risk. About 10 per

cent of them become malignant. The most serious complications are lesions of the carotid arteries or jugular vein followed by fatal hemorrhage or air embolism. Hemorrhage can be controlled by placing a tape around the common carotid artery at the beginning of the operation. When the internal jugular vein can be isolated from the tumor a ligature should be placed centrally and peripherally from the tumor and the fixed piece of vein resected. The danger of air embolism can be prevented in this way.

The author describes 7 cases of his own 5 in females and 2 in males the ages of the patients varying from 24 to 60 years. In 6 of the cases the growth was on the right side and in 1 it was on the left. The diagnosis was established before operation in all of the cases. In 2 cases primary extirpation was performed in 1 biopsy and secondary extirpation were done and in 3 cases biopsy only was done. There were no complications in 6 cases. In the seventh there was a hemiplegia which, however, disappeared in 2 weeks. Histological examination showed 5 cases of typical carotid tumor 1 case of fibroma and 1 of neuroma. There were no signs of malignancy in any of the cases. AUGUST G. MORGAN, M.D.

Rottino, A., and Howley, C. F.: Osteoid Sarcoma of the Breast; A Complication of Fibroadenoma. *Arch. Path., Chic.*, 1943 40 44.

The authors present a case report of an unusual tumor of the breast containing osteoid tissue. Their patient suffered from a rapidly growing neoplasm which recurred three months after it was removed and which caused death in ten months despite intense roentgen therapy.

Although the regional lymph nodes remained free, the lungs became seeded with metastases. One of the outstanding gross characteristics of this type of tumor was present in theirs namely, a large cyst filled with necrotic, hemorrhagic debris. The cyst had evidently developed through a process of necrosis and liquefaction of a portion of the tumor. Hemorrhage represented a late complication.

The tumor itself was abundantly cellular and the cells were polymorphic. Outstanding among these were numerous multinuclear giant cells. Another important finding in the case was osteoid tissue described in only 9 of the 25 cases assembled from the literature.

In 10 of the cases reported in the literature, fibroadenoma was observed in intimate association with the giant-cell tumor. In some cases there were only remnants of fibroadenoma. In a few others the main tumor was fibroadenoma and the osteoid and giant-cell phase of the growth was observed developing within it.

Stillings was the first to propose that the giant-cell tumor arose in the fibroadenoma. Many have since agreed with him including the authors. Granting this to be a fact namely that a stage of uncompleted fibroadenoma precedes the cancerous phase one can see a meaning to the clinical awareness of the tumors for twelve, nineteen and even thirty years

2 exceptions was 25 per kgm. of body weight. The amount of swelling was either comparable with or less than that found in Group II and in those experiments in which the ligatures were removed one hour after the trauma, there was little additional swelling apparent. This was indicative of early arrest of hemorrhage while the limb pressure was low. The systemic blood pressures were in some instances slightly to moderately reduced, but in no case did shock develop.

In those animals which were sacrificed from one and one tenth to three and one tenth hours after trauma the local fluid loss with a few exceptions was less than half that of control Group I, and was not enough to produce shock. The animals that were allowed to survive were in good condition the following day.

In Group I the rapid swelling of the limb and the large amount of local fluid loss (which at necropsy was found to be blood in very large measure) are evidence that factors other than hemorrhage did not play an important part in the production of shock and death. In Group II the animals were protected from shock through the action of the spinal anesthetic in blocking the vasomotor and (less important) motor nerves lowering the blood pressure, and reducing the hemorrhage below a level that produces shock. There was no evidence that blockage of nociceptive stimuli was an important factor in preventing shock. In Group III the trauma was greater than in Group I and as the nerves were intact, the flow of nociceptive stimuli should, therefore, have been as great as or greater than in Group I. Still shock did not develop.

There is no evidence in these experiments of an important action from toxins formed in the damaged tissues since, if present, it should have been manifest in Groups II and III in which the trauma was greater than in Group I. In the animals in Group I the onset of shock was too rapid to have been caused by toxins.

Swingle and coworkers confirmed the work of others that section of the nerves to the limbs or of the spinal cord at the thirteenth thoracic or first lumbar vertebra does not prevent shock from limb trauma. This would preclude the possibility that any protection obtained from procaine injections of the nerves or tissues was the result of blockage of nociceptive stimuli from the traumatized regions. The theory that the descending tracts of the ventromedial areas of the cord protect against limb-trauma shock, but that afferent nociceptive stimuli from the legs, apparently transmitted by the ventrolateral cord regions, eliminate this factor and sensitize to shock, was tested experimentally as follows: the left dorsal spinal nerve roots below the twelfth thoracic vertebra were sectioned, which destroyed all afferent impulses from the left limb. When the limb was subsequently traumatized there was no sign of protection against shock, as the animals tolerated blood loss and tissue damage no better than did the normal dogs of Group I.

Joux L. Laroque M.D.

Phemister D. B., Eichelberger L., and Laester C. H.: Early Effects on Dogs of Section of the Eighth Cervical Segment of the Spinal Cord and Their Bearing on Shock. *Arch. Surg.* 945 51 J

Since it has been considered that nervous factors may play an important part in the production of surgical shock by lowering the blood pressure and impairing the circulation, it should be of interest to study the physiological morphological and biochemical reactions in animals in which the blood pressure is lowered by the alteration in nervous function which follows section of the eighth cervical segment of the spinal cord.

The most immediate general effects are motor and sensory paralysis distal to the level of section and vasomotor paralysis complete except for the vasodilator fibers to the chorda tympani and glossopharyngeal nerves and the antidromic pathways of the posterior roots of the cervical nerves. After a brief initial rise there follows a marked fall of blood pressure, a slowing of the pulse and respiration, a fall of the body temperature and a variable degree of depression or stupor which usually wears off within 24 hours. The excitability of all somatic, vascular, and visceral reflexes posterior to the section is diminished. This early state of the animal was defined by Sherrington as spinal shock.

The most widely accepted theory as to the cause of the fall in blood pressure following section of the spinal cord at the eighth cervical vertebra is that interruption of the pathways to the sympathetic nervous system cuts off vasoconstrictor impulses coming from the higher centers. Diminution of respiratory movements by paralysis of the intercostal muscles and of intra-abdominal tension by paralysis of the muscles of the abdominal wall contributes somewhat to the hypotension. It has also been maintained that the flaccid paralysis of skeletal muscles from the interruption of motor pathways results in dilatation of the capillaries venules and veins and that the subsequent pooling of blood from lack of extravascular muscular support is an important contributing factor to the lowering of the blood pressure and the impairment of the general circulation. This theory is contradicted by the decided fall in blood pressure which results from inhibition of the vasoconstrictors produced by stimulation of the depressor nerves and there is still doubt as to the degree of its importance.

The state of pronounced general depression and low blood pressure known as spinal shock, which follows section of the eighth cervical segment of the spinal cord in dogs does not lead to surgical shock if the animals are given adequate fluids food, and nursing care. The general depression gradually decreases while the blood pressure persists at the upper limits of the shock level for from 4 to 6 days before the onset of a slow, gradual elevation to preoperative levels. During this acute period of vasodepression there is additional evidence of impairment of the circulation, as shown by a moderate to severe reduc-

tion in the erythrocytes hemoglobin, and red cell volume. Limited studies indicate a slight reduction in the total blood volume. There is also a significant reduction in the serum protein and the oxygen and carbon dioxide content of the blood. Changes in the water chloride and sodium concentrations are small. Calcium concentrations are reduced, while potassium concentrations show a noticeable rise. The most important cause of these changes appears to be the trapping of erythrocytes in the tissues under conditions of vasodilation and low blood pressure.

When after section of the cord the animals were kept in the dorsal position on the operating table with wounds in each thigh for the insertion of cannulas in the femoral arteries and fluids and food were withheld, they reacted the same as the other group of animals during the first 6 to 12 hours. Thereafter the general depression began to increase and the blood pressure declined usually to very low levels where it remained for from 12 to 24 hours with the animals in a state of shock until death occurred. The hematological changes were similar to those of the earlier period of the first mentioned group except that there was a terminal trend toward hemoconcentration. Necropsy revealed evidence of acute degenerative changes in some of the tissues which were interpreted as being due primarily to anoxia.

In both types of experiments the animals were definitely more resistant to low blood pressure than has been found to be the case with animals in which the blood pressure was reduced to equally low levels by hemorrhage or local loss of fluid from injury. This is interpreted as being due to the fact that after the section of the cord there are vasodilation and better nutrition of the tissues than is the case after straight hemorrhage or the local loss of fluids from an injury with low blood pressure in which there is vasoconstriction. The observations support the view that a low blood pressure produced by the exclusion of vasoconstrictor activity whether from direct injury of the pathways or from reflex inhibition, causes less impairment of the circulation and less tendency toward shock than does an equally low blood pressure produced by hemorrhage or by local loss of fluid from injury. The administration of adequate amounts of water, electrolytes and food protects against circulatory failure when the blood pressure is at a low level as a result of the exclusion of vasoconstrictor activity by a spinal cord injury.

BENJAMIN GOLDMAN, M.D.

Mahoney, E. B., Howland, J. W., and Yackel, K.
The Role of Infection in Shock Produced by Muscle Injury. *Surgery* 1945 17: 803

Shock was produced in dogs by means of the Black crusher. The inoculation of virulent cultures of the streptococcus hemolyticus and the clostridium welchii into the thigh muscles just before application of the crusher modified the resulting shock. The survival time of animals inoculated with the former organism was two hours less than that of the control animals and of those inoculated

with the latter organism it was three hours less than that of the controls. The staphylococcus aureus injected into the thigh muscles before injury did not alter the survival time under the conditions of these experiments.

There was no greater fluid loss in the infected animals than in the controls and the decreased survival time was considered to be due to the infection of traumatized muscle and to circulating bacterial toxins. The infected animals did not have a secondary rise in blood pressure following the primary fall.

JOSEPH GARTER, M.D.

MEDICAL JURISPRUDENCE

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Industrial hygiene as a science and as a public health service has been developed with the objective of protecting and promoting the health of the working population in an industrial system. Governmental agencies have taken action in solving industrial health problems because such action is a proper obligation of public agencies. Management has co-operated partly because of the necessity of the requirements imposed by certain types of work men's compensation acts and partly because management has gradually realized that there are other phases of the problem in need of attention. It has already begun to extend its surgical treatment work into such functions as pre-employment and periodic physical examinations, and in recent years into medical and engineering control of occupational diseases and job placement. Finally at present attention is being devoted to such problems as general illness among workers and to such factors as fatigue, dental hygiene, nutrition, mental health and similar adult health problems. Labor as represented by both organized and unorganized workers has had a lesser role in this development, largely because strong organization is necessary for effective action, and until recently unions have not been well enough established to allow them to give attention to the advancement of special welfare programs.

There is no reason, however, why labor cannot accomplish tasks in relation to the social front as it has already done through years of hard work on the political front. It will probably not be necessary for labor to go through as long a period of self-education as did management, since many of the patterns in this field of effort have already been developed, however the labor front should go slowly and recognize that it has a good deal to learn in the field of industrial health. Labor will find official and non-official health agencies ready to assist it in this educational process.

Co-operation between labor and management appears still to be in its infancy, more education in the technique of co-operation is needed for both industry and the unions. Labor-management committees sponsored by the War Production Board have served a useful function in stepping up pro-

duction for the war effort however when they have functioned in the permanent health and welfare activities the results have not been impressive. Attention to workers' health has been perfunctory, new opportunities for the improvement of working conditions and the worker's health have not been explored extensively by the labor management committees. In fact, Robert Watt, labor member of the War Labor Board believes that collective bargaining under the Board itself has served already to accomplish far more than these committees can do. The Board itself as distinguished from its committees being the best demonstration of the value of economic democracy. It is true, of course that the union agreement between management and labor negotiated through collective bargaining (as sponsored by the War Labor Board) offers one channel for the improvement of industrial health and working conditions. Health and safety provisions are specified in a number of existing contracts, however a study of the health and safety clauses shows that these provisions have been made in order to protect workers from unfair application of company reg-

ulations to right some specific grievance or to correct some single outstanding hazard. As far as can be determined, no union agreement provides for a broad industrial health program in the industry concerned with a view to long term reduction of sickness and the promotion of positive health.

All in all the major health problems of the working population cannot be solved by union agreements or by management or by labor alone.

A comprehensive national health program administered by state and local governments would meet the needs of all groups for health and medical service, hospital care and prevention of disease. It would be far more desirable to revise and strengthen our present laws on health and safety requirements, and especially their enforcement provisions. In such manner benefits of such laws could be applied to all workers rather than to those who happen to be strong enough to obtain concessions through contracts. Through such collective action on the legislative front the rights of neither management nor labor nor their free functioning will be impaired.

JOSIE W. BIRNBAUM, M.D.

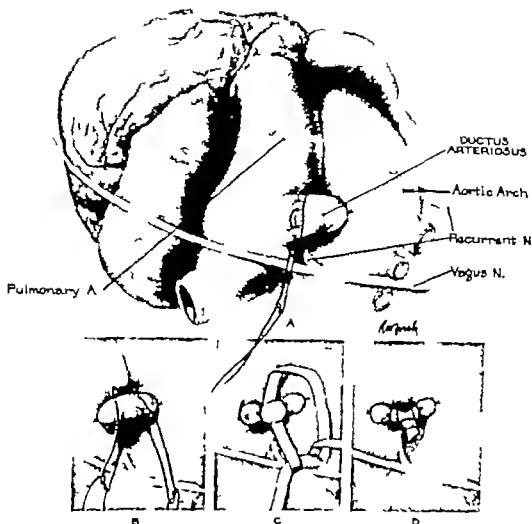


Fig. A, Pursestring suture placed and tied on aortic side, placed but not tied on pulmonary side. B, Both pursestring sutures tied mattress sutures placed. C, Mattress sutures tied umbilical tape ligature placed. D, Umbilical tape tied.

Operative Closure of Patent Ductus Arteriosus—Alfred Blalock

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OPERATIVE CLOSURE OF THE PATENT DUCTUS ARTERIOSUS

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ALTHOUGH a procedure for closure of the patent ductus arteriosus had been described by Munro in 1907 and although the operation had been attempted by Strieder (1) the first successful closure of an open ductus was performed by Gross (3) in 1938. The first method used by Gross was that of simple ligation of the ductus. It is well known that the lumen of a large artery which is closed by ligation in continuity may become patent again as the ligature cuts through the wall. Gross abandoned the method of simple ligation after having used it on 14 patients because there was evidence that the occlusion did not remain complete in several patients. More consistent closure of the ductus was obtained by Gross in 28 patients by the use of a second method in which the ductus was ligated and was also surrounded by cellophane. Some recurrences developed after this procedure and these led Gross (2) to develop a third method which consists of complete division and closure of the ductus. This procedure had been used on 14 patients at the time of the last report and the results were satisfactory.

It is because I question the necessity and safety of performing an operation in which the ductus is cut across and the ends closed

that this brief communication is presented.

During a period of slightly less than 3 years my associates and I have operated upon 19 patients with patent ductus arteriosus most of whom were referred by Dr. Helen Taussig. There have been no serious accidents during the operations and no postoperative deaths in the hospital. Two of the 6 patients who had a *Streptococcus viridans* infection died subsequent to discharge from the hospital. There was definite evidence in only 1 patient that the lumen of the ductus became re-established following the initial closure. Two ligatures of braided silk were used in closing the ductus of this patient. It was noted at the time of operation that the ductus was quite short and that the ligatures overlay each other. Following the development of evidence that the ductus had reopened a second closure was performed. This patient had a *Streptococcus viridans* infection and she died 3½ months following the second operation.

We have used a number of different methods in our small series of cases. It is difficult to compare the effectiveness of the different methods because there has been evidence in only the 1 case referred to that the lumen of the ductus became re-established. In the earlier cases we used two ligatures of braided silk with or without an additional ligature of

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umbilical tape. In 2 patients the recent method of Gross (2) was modified to the extent that pursestring sutures of silk were placed at the extreme ends of the ductus. These were tied loosely and two straight clamps were placed on the ductus between the pursestring sutures. The ductus was divided between the clamps and the ends were closed with suture ligatures. Although no difficulty was encountered it was felt that the division of the ductus probably exposed the patient to unnecessary danger of severe hemorrhage. We then adopted the method which has been employed in 7 patients and which is used at the present time. The entire length of the ductus is carefully dissected free of the adjacent structures. Pursestring sutures of medium silk on French needles are placed at the two extreme ends of the ductus. The adventitia is caught in the suture in several places. These sutures are tied loosely yet sufficiently tightly to abolish the flow of blood through the ductus. Two through and through mattress sutures of silk are placed and tied between the two purse-

string sutures. A ligature of umbilical tape is then tied over the mattress sutures of silk. The method is shown diagrammatically in Figure 1.

There has been no evidence in the patients in whom this method has been used that the lumen of the ductus has become re-established. If subsequent experience corroborates this impression, it would seem that the method is preferable to that of division of the ductus because it subjects the patient to less danger of fatal hemorrhage. Even if division and closure of the ductus proves to be the method of choice it would seem that the procedure can be made less dangerous by the preliminary placing of pursestring sutures at the extreme ends of the ductus.

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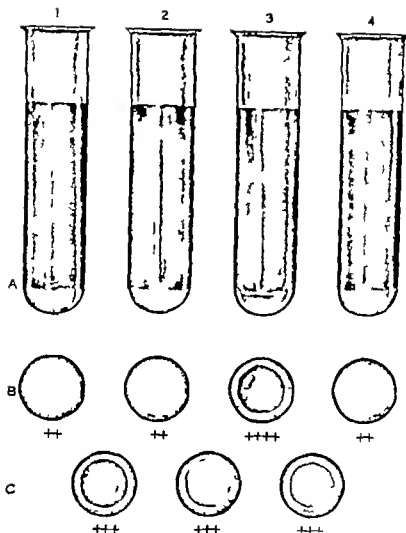


Fig. Blood amylase activity as measured by cuprous oxide precipitation. A soluble starch is used. To measure decreased blood amylase activity it is advisable to use more sensitive starch. Row A. Tube 1 is normal control with a very small amount of light brown cuprous oxide precipitate uniformly distributed on the bottom. This may sometimes come down as a very slender yellow ring.

Tube 2, Case 75835, group 1 is read as normal though a trifle more precipitate appears in it than in the control. The test was done during an attack of cholangitis. It was repeated twice and found normal on both occasions.

Tube 3, Case 73 96, group 5 or Case 3 Table I, with blood amylase activity markedly increased. Acute hemorrhagic pancreatitis found at necropsy (see Fig. 1).

Tube 4, Case 73 65, group 1 or Case 3 Table I with blood amylase activity normal. Chronic pancreatitis found at operation. This patient recovered. Row B. The bottoms of tubes in Row A. Row C. Variations in the rings or bottoms of precipitates obtained with soluble starch. When the more sensitive starch is used this is the type of precipitate one is apt to get with the normal control.

BLOOD AMYLASE ACTIVITY IN PANCREATITIS AND OTHER DISEASES

A Simple Diagnostic Aid

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IT is the purpose of this article to call attention to the evaluation of blood amylase activity in pancreatitis and other diseases and to a simple diagnostic aid (16), which measures blood amylase activity in terms of cuprous oxide precipitation. The test is almost as simple as the determination of sugar in urine and it has now been used with increasing success for over 4 years.

This study is based on 78 blood amylase activity determinations in 69 patients. In 62 patients the diagnoses were proved by acceptable criteria such as necropsy, operation, biopsy, x-ray, laboratory, or combinations of these. Though in 7 patients the diagnoses were unproved, the cases have been included in this series for the more conservative statistical evaluation of the incidence of proved pancreatic disease. In 63 patients the tests were run to rule in or to rule out acute pancreatitis, carcinoma of the pancreas, or to determine the blood amylase activity in biliary tract and other diseases. And the test was run in one case of pancreatic collection (pseudocyst) which was observed at the Newark City Hospital; the complete report of which is included in this series through the courtesy of Dr. R. O. Bauman.

CASE REPORTS

In this series of 69 cases there were 6 cases of acute pancreatitis proved at operation or at necropsy. The case of pancreatic collection was proved at operation. Because of its clinical importance, a case of mesenteric and portal vein thrombosis associated with a marked blood amylase activity is also reported.

CASE 1: History No. 73165. M. L. female, white, aged 45 years, housewife, was admitted to the hospital May 15, 1943.

From the General Surgical Service, Barnert Hospital, Paterson, New Jersey, and the Thoracic Service, Bergen Pines Hospital, Ridgewood, New Jersey.

About 1 month prior to admission the patient suffered indigestion. She vomited after breakfast and had severe pain over the entire lower abdomen. The attack was accompanied by belching, a bitter taste, and pain which radiated to the back and to the shoulder blades. She gave a history of previous attacks of a similar nature.

On physical examination a marked enlargement of the abdomen was noted. A smooth, hard mass was felt in the pelvic region below the umbilicus. This mass was movable and not tender. There was marked distention in the epigastrium and tenderness over the gall bladder region. However, the gall bladder could not be felt.

In the left upper abdomen there was a mass just below the left costal border which extended backward toward the kidney. There was tenderness in the left costovertebral angle. This mass felt more like the kidney than the spleen. It was thought that free fluid was in the peritoneal cavity. Moderate icterus was present.

Laboratory examinations of blood May 15, 1943, showed: icterus index 35, hemoglobin 12 grams per cent, red blood cells 4,440,000, white blood cells 21,200 with large mononuclear leukocytes 4 per cent, lymphocytes 6 per cent, eosinophils none, band forms 9 per cent, polymorphonuclear leukocytes 81 per cent. Examination of the urine showed specific gravity 1.013, a trace of albumin, no sugar, no acetone. On microscopic examination there were found a few white blood cells, an occasional red blood cell, no casts.

On May 18, 1943, 3 days after admission, a blood amylase activity test was performed and found to be normal (2 plus) (see Fig. 1, row A, tube 4).

On May 27, 1943, 12 days after admission, a supracervical hysterectomy was performed. At operation the gross findings were those of a large uterus with intramural fibromyomas, cholelithiasis, free fluid in the peritoneal cavity, and fat necrosis in the area of the pancreas.

On June 10, 1943, the patient was discharged, recovered. She was readmitted in August, 1943, and on August 23, 1943, a cholecystectomy was performed and the patient was subsequently discharged, recovered.

Pancreatitis as a cause for this patient's chief complaints was definitely considered prior to operation. The blood amylase activity test was found to be normal. It is a known

fact that blood amylase activity rises sharply at the onset of an attack of acute pancreatitis and may subside just as sharply within 72 hours of the onset. For that reason one should not sacrifice the judgment gained by years of clinical experience for a noncorroborative diagnostic laboratory aid. Briefly a normal blood amylase activity report does not rule out the presence of acute pancreatitis whereas a moderately or markedly increased blood amylase activity rules strongly in favor of acute pancreatitis.

Attention is invited to the fact that the patient was observed for 12 days prior to the first operation when the pelvic pathological lesion was removed. The initial symptoms had subsided, the patient was in good condition for operation, all thoughts of acute pancreatitis had vanished in the light of the normal blood amylase activity so that the presence of fat necrosis in the area of the pancreas came as a mild surprise.

CASE 2. History No 72105 D V, female white, aged 53 years, was admitted to the hospital March 20, 1943, with a chief complaint of pain in the epigastrium of 6 months duration. The pain was more severe after she ate heavy food and was occasionally associated with vomiting. In the past 3 months the epigastric pain was much more severe and came more often. She had lost 10 pounds (4.5 kgm.) of weight in the past 3 months. The epigastric pain had been very severe for the past 10 days.

On physical examination there was found a definite tenderness in the epigastrium and right upper quadrant of the abdomen. A mass was palpable in the gall-bladder region and it extended two fingers below the costal margin. The temperature was 100 degrees (37.2 C.), pulse 68, regular, blood pressure 130 millimeters of mercury systolic, 80 millimeters of mercury diastolic.

Laboratory examination of urine showed specific gravity 1.020, albumin, a trace, no sugar, acetone a trace. Examination of the blood showed hemoglobin 3 grams per cent, red blood cells 3,600,000, white blood cells 7,900 with large mononuclear leukocytes 2 per cent, lymphocytes 14 per cent, eosinophils 1 per cent, polymorphonuclear leukocytes 83 per cent.

Clinical impression: acute cholecystitis. On March 23, 1943, 3 days after admission, operation was performed. A hemorrhagic pancreatitis with fat necrosis, cholecystitis and cholelithiasis were found. Cholecystostomy, removal of gall stones and drainage were done.

The pathologic report (by Lt. J. Churg) (1) Portion of gall bladder wall showed edema and chronic inflammation. (2) cholelithiasis. (3) portion of fat tissue showed small areas of necrosis.

The blood amylase activity test was performed 5 days after the operation and was moderately (3 plus) increased. The patient was not relieved by the operation. She became depressed, continued to vomit and finally expired on May 1, 1943, 39 days after the operation.

Since only one blood amylase activity test was performed we are left in the dark as to the changes that took place in the pancreas from a secretory point of view. There was no necropsy so we do not know the exact cause of death. We were left with the impression that a moderate blood amylase activity increase may be associated with a serious prognosis in acute pancreatitis. This case also emphasized the fact that blood amylase activity tests should be run every day or every other day since it is known that blood amylase activity usually parallels the course and the clinical symptoms of pancreatitis (10).

CASE 3. History No 73106, J. J. male, aged 60 years, was admitted to the hospital May 17, 1943, and died May 19, 1943.

His chief complaint was severe abdominal pain and vomiting. The onset occurred on May 13, 1943, with pain in the precordium which extended down the left arm. This recurred the following day, May 14, 1943. On May 17, 1943, the patient was seized with severe pain in the upper abdomen followed by continuous vomiting. The patient then developed severe shock associated with a subnormal temperature and a cold, clammy skin.

The patient had had an attack of severe abdominal pain followed by nausea and vomiting in October, 1941. At that time there was some tenderness over the abdomen but no rigidity.

Physical examination revealed a soft, distended abdomen, with no areas of rigidity but tenderness was present on pressure and rebound.

Laboratory examinations revealed white blood cells at 500 with a marked shift to the left. The blood amylase activity was markedly increased (4 plus) (see Fig. 1, row A, tube No. 3).

The patient went rapidly downhill with a rising temperature. He died 48 hours after admission.

The pathologic diagnosis (necropsy by Lt. J. Churg) was as follows: acute hemorrhagic pancreatitis, widespread peritoneal and retroperitoneal fat necrosis, periesophageal fat necrosis, hemorrhagic effusion in the peritoneum (800 c.c.) and in both pleural spaces (200 c.c.), chronic cholecystitis and cholelithiasis, pulmonary emphysema, atelectasis of both lower lobes, pulmonary edema and congestion, arteriosclerosis of the kidneys.

Acute hemorrhagic pancreatitis was the cause of death but coronary thrombosis was the foremost clinical diagnosis in the minds

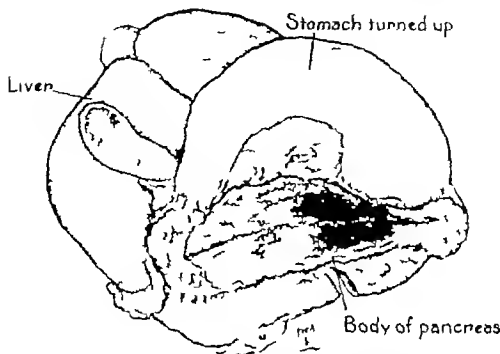


Fig. 1. Gross specimen of Case 73190 group 5 or Case 3, Table I. The under surface of the liver, the gall bladder and the stomach are turned up. The pancreas has been cut transversely and opened like a book. The acute hemorrhagic process can be seen in the body and the tail of the pancreas. There were numerous plaques of fat necrosis in the head and tail of the pancreas as well as in the peritoneal and retroperitoneal structures.

of the attending physicians for 3 days prior to admission of the patient to the hospital when the clinical state of the patient was that of epigastric pain and vomiting. A diagnosis of acute hemorrhagic pancreatitis was then made and confirmed first by the *marked increase (4 plus) in blood amylase activity* and then by necropsy (Fig. 2).

CASE 4. History No 76645 S. E. male white aged 44 years was admitted to the hospital February 28 1944 with a chief complaint of severe epigastric pain followed by nausea and vomiting. The present illness began 2 days prior to admission. In September 1943 the patient had suffered a severe attack of epigastric pain associated with severe vomiting and nausea. There was no jaundice and the pain radiated to the right shoulder. The pain started suddenly and stopped suddenly. The patient was well for 3 weeks and then had a repetition of the symptoms named. In October 1943 an x-ray series revealed the presence of stones in the gall bladder. Shortly after this the patient suffered another attack of severe epigastric pain. He was placed on a strict diet and was free from pain until 2 days prior to admission on February 28 1944.

On physical examination the patient appeared to be acutely ill. There was no clinical icterus. The abdomen was distended and there was an a

lated marked rigidity and exquisite tenderness in the right upper quadrant of the abdomen over the gall-bladder region. There was no tenderness in the costovertebral angles. The temperature was 90 degrees (37.2 C) the pulse 94 respirations 18.

Laboratory examination of the urine revealed reaction acid specific gravity 1.030 albumin a trace sugar 3 plus acetone negative. On microscopic examination a few white blood cells were found but no red blood cells no casts or bacteria were present. Blood count showed white blood cell 18,500 hemoglobin 17.0 grams per cent red blood cell 5,500,000.

Clinical impression acute cholecystitis with cholelithiasis.

Cholecystectomy and choledochotomy were performed on the day of admission February 28 1944. A large amount of bloody fluid was present in the peritoneal cavity. There was hemorrhage into the pancreas. Fat necrosis of the pancreas was present, and a large number of stones were found in the gall bladder. The common duct was dilated but no stones were found in it.

March 1 1944 2 days after the operation a blood amylase activity test was performed and reported markedly increased (4 plus).

Pathologic diagnosis (Dr A. J. Giltz) acute cholecystitis with prominent acute petechial hemorrhage into the omentum fat showing areas of fat necrosis and in specific acute inflammation chronic cholecystitis.

TABLE I.—SUMMARY OF 6 CASES OF PANCREATITIS PROVED AT OPERATION OR AT NECROPSY

Case No.	History No.	Diagnosis and remarks	Blood amylase activity
	71405	Chronic pancreatitis, cholecystitis, cholelithiasis. Operation 3-12-43. Cholecystectomy. Died 3-1-43.	3 plus. Test done 3 days postoperative
	71185	Chronic pancreatitis, cholecystitis, cholelithiasis, Strumoma testis. First operation 3-17-41, hysterectomy. Discharged, recovered, 6-10-41. Second operation 8-12-41, cholecystectomy. Discharged, recovered.	plus (normal). Test done 6 days prior to first operation
3	73196	Acute hemorrhagic pancreatitis, chronic cholecystitis, cholelithiasis. Admitted 2-7-42. Died 3-19-42. Necropsy	4 plus. Test done the day of admission
4	76643	Acute hemorrhagic pancreatitis, chronic cholecystitis, cholelithiasis. Operation 2-28-42, cholecystectomy and cholecystectomy. Discharged 3-27-42, recovered	4 plus. Test done 3 days postoperative
5	79813	Acute hemorrhagic pancreatitis, chronic cholecystitis, cholelithiasis. Admitted 11-17-44. Operation 1-19-45, Strumectomy. Died -10-44. Necropsy	3 plus. Test done the day before operation
6	82077	Acute pancreatitis (pancreas indurated, nodular associated with fat necrosis). Cholecystectomy performed 16 yr prior to present admission. Admitted 2-22-45. Operation 3-27-45, cholecystectomy. Discharged 6-28-45, recovered	3 plus. Test done 3 days after admission. 14 plus 3 days later, associated with clinical improvement, 3 days prior to operation

On admission the patient was in no distress. She was well developed, well nourished, and exhibited no rashes or icterus. The positive findings were as follows: blood pressure 130 millimeters mercury systolic, 90 millimeters mercury diastolic. In the left upper quadrant of the abdomen there was a mass about the size of a grapefruit which protruded only slightly above the abdominal contour. This mass extended into the epigastrium where it was tender. The possibility of two masses was considered.

Provisional diagnosis malignant growth of the stomach splenomegaly of unknown etiology.

Retrograde pyelography disclosed no pathological process. Cystoscopy disclosed none. Peritoneoscopy revealed a mass in lesser omental cavity perhaps a cyst of the pancreas the stomach displaced anteriorly. X-ray (barium enema) examination revealed evidence of pressure at distal third of transverse colon and splenic flexure probably due to extrinsic pressure. Chest examination revealed left diaphragm flat and slightly elevated. Thoracic and lumbar vertebrae showed no evidence of the presence of pathology.

Laboratory examination of the urine revealed albumin, 2 plus, concentration good. Examination of feces for undigested fats gave normal findings. Blood chemistry examination revealed normal values for sugar, urea, nonprotein nitrogen, and creatinin. White blood count showed 9,150 polymorphonuclear leucocytes 64 per cent. Red blood cells numbered 3,000,000 to 4,000,000 hemoglobin range was 56 to 60 per cent.

The size of the mass fluctuated slightly, and its tenderness was intermittent. On the fourth day of admission the patient awoke with severe substernal pain which did not radiate. This attack was accompanied by profuse diaphoresis. Dyspnea was experienced but no cyanosis was visible. There were no chest signs.

Clinical impression (1) possible small pulmonary embolus (2) possible coronary episode.

The abdomen continued to be painful and the patient was brought to surgery. A left rectus incision revealed a fluctuant mass above and behind the stomach. The foramen of Winslow was closed. A nick was made in the gastrohepatic mesentery and the mass was drained of about 2000 cubic centimeters of brown, bile-stained or coffee-colored fluid with little odor. This sac was packed with plain gauze. The sac was marsupialized and the gauze was left hanging outside. The abdomen was closed in layers after a piece of the sac wall was excised for biopsy.

The postoperative course was uneventful. The cavity continued to drain small amounts of coffee-colored fluid. The drain was ultimately removed and the patient was discharged, 5 weeks after admission.

A biopsy specimen of the cyst wall revealed fibroblastic tissue. Organisms were not found. The blood amylase activity done several days after operation, by the cuprous oxide precipitation method (16) was found to be markedly increased (4 plus).

A letter from Dr. Richard O. Bauman, dated June 18, 1942 states "Enclosed is a summary of the case you were interested in. She is now discharged even though she has considerable drainage from the marsupialized sac or cyst."

"It was the opinion of some of the men on the staff that this lesion came under the group classified as pseudocysts of the pancreas. Biopsy of the cyst wall and other evidence such as a closed foramen of Winslow and the presence of old inflammatory fibrosis seem to substantiate this but then again, we could not be sure. A follow up is in order."

The patient could not be followed up further.

The increased blood amylase activity found in this case helped the staff lean toward a diagnosis of pseudocyst of the pancreas. Pinkham, in a review and analysis of 10 cases of pancreatic collections (pseudocysts) states

that "Persistent elevation of the serum amylase following the signs and symptoms of pancreatitis or pancreatic necrosis is significant, indicating the probable development of a pancreatic collection

Thus we are once again reminded that single blood amylase determinations while very valuable in the acute case are not as valuable as repeated determinations where the clinical diagnosis is in doubt and the condition of the patient permits study over a period of days prior to operation

ANALYSIS OF CASES

Group 1 Of the 69 patients tested 37 (53.6 per cent) were found to have a normal blood amylase activity. As we gained experience with the interpretation of blood amylase activity we discovered that a normal blood amylase activity is a true source of comfort. In only 1 instance (Case No. 73165 which is reported here in detail) was a proved pancreatitis found associated with a normal blood amylase activity and this patient recovered.

A white female, aged 60 years. Case No. 75446 was admitted to the hospital with a chief complaint of severe epigastric pain and vomiting. This was associated with an intense icterus. She had had a cholecystectomy 10 years before. A gastrointestinal x-ray series revealed the presence of a tiny herniation of the stomach through the diaphragm, a duodenal diverticulum, a shadow as of a stone in the region of the right kidney or gall-bladder bed. Consultations were held. A clinical diagnosis of common duct stone was made and it was desired to rule out an associated acute pancreatitis. The blood amylase activity was normal. A stone in the common bile duct was found at operation. The pancreas was not inflamed. A choledochotomy was performed, the stone was removed and the patient made an uneventful recovery.

Case No. 79776 illustrates the use of blood amylase activity determinations in the location of intestinal obstruction. In 1933 it was reported (15) that increased blood amylase activity may be found in high intestinal obstruction and in 1940 Johnson and Bockus reported an elevated serum lipase in intestinal obstruction. It is conceivable that pancreatic enzymes may be reabsorbed into the general circulation from severely distended small intestines before viability of their walls is lost.

In Case 79776 the diagnosis of intestinal obstruction was quite certain and the normal blood amylase activity not only served to rule out acute pancreatitis but made it seem likely that the obstruction was low. At operation the ileum was found twisted on itself and so adherent to the posterior peritoneal wall of the peritoneum in the right vertebral gutter that it could not be released without fear of tearing it. An ileostomy was performed. The patient died 12 hours later. At necropsy 5 days after the onset of the illness 1 foot of ileum was found gangrenous about 1 foot from the cecal end. This gangrenous loop of ileum was found firmly caught under a free edge of the root of the mesentery and explained the inability of the operator to free this 12 hours earlier.

Group 1 includes 3 patients with serious kidney pathology (cases Nos. 77219, 80353 and 82145) with carcinoma of the right kidney, left pyelitis cystica and uremia respectively. Since urine excreted by normally functioning kidneys has an amylase activity of 2 to 6 times that of blood many attempts have been made to correlate kidney function with blood amylase activity or urinary amylase activity. It is reasonable to expect a normal blood amylase activity in the first 2 cases mentioned because only one kidney was involved in each of these patients. In the third case in which the patient died of uremia one is at a loss to account for the normal blood amylase activity for with markedly diminished kidney function one does expect an increased blood amylase activity. However, the problem is not as simple as all that for it is conceivable that associated liver damage may be the responsible factor. Considerable study is required to correlate kidney function with blood and urinary amylase activity. Dozzi has concluded that there is no quantitative relationship between blood and urinary amylase.

Eleven patients with biliary tract disease appear in group 1. Since in our experience acute pancreatitis was found associated with biliary tract disease in all (100 per cent) of the 6 proved cases of acute pancreatitis a normal blood amylase activity in biliary tract disease has come to be regarded by us as safely excluding an associated acute pancreatitis or that a pre-existent acute pancreatitis is subsiding.

Group 2 In group 2 are 7 cases with decreased (1 plus) or absent (zero) blood amylase activity.

ase activity (10.1 per cent of the 69 patients observed) In this group the decrease was in no instance associated with acute pancreatitis.

The liver is considered by some observers, among them Dozzi to play some part at least in the formation of amylase. For that reason a decreased or absent blood amylase activity has been interpreted as evidence of unpaired liver function. Lewison has reported a depressed serum amylase in liver disease. Bartlett studied blood amylase activity in thyroid disease and concluded that a decreased blood amylase activity indicates impaired liver function in that condition.

A decreased or absent blood amylase activity may be found in any chronic, wasting disease such as tuberculosis (4 cases) or carcinoma (1 case). In tuberculosis amyloidosis of the liver is a common finding. In carcinoma of the stomach metastatic nodules may replace most of the normal liver tissue.

There were 2 cases of biliary tract disease in group 2—decreased (1 plus) or absent (0) blood amylase.

The first H. W., a white female, aged 68 years was admitted with a chief complaint of severe right upper abdominal pain. This pain was associated with an intense icterus. X-ray examination disclosed a nonfunctioning gall bladder. The laboratory reported a blood picture of severe pernicious anemia with a red blood cell count below two million. The blood amylase activity was decreased (1 plus). The patient improved remarkably under crude liver extract therapy and was discharged, improved. A year later she suffered another attack of gall-bladder colic and submitted to operation chronic cholecystitis and cholelithiasis were found cholecystectomy performed and the patient is alive and well today though she has to continue with liver extract therapy.

Since in Group 1 there were 2 cases of pernicious anemia (Nos. 72400 and 81248) and 11 cases of biliary tract disease one cannot be sure that pernicious anemia *per se* is responsible for the decreased blood amylase activity in the first case in group 2 (H. W.) nor that the biliary disease is responsible for the decreased blood amylase activity in both Case 1 H. W. and No. 74702 in group 2.

Suffice it to say that in the present state of our knowledge of decreased blood amylase activity one may safely regard such decrease as ruling out serious pancreatic disease. And

that while a decreased blood amylase activity may point toward decreased liver function one should use other and better known liver function tests when the function of the liver is under investigation.

Group 3. In group 3 there were 9 cases with slightly increased ($2\frac{1}{2}$ plus) blood amylase activity (13.1 per cent of the 69 patients observed). In none of these were we able to prove that acute pancreatitis was present. Several impressions were gained from a study of these cases of slightly increased blood amylase activity: (a) single determinations of blood amylase activity are not as valuable as repeated determinations; (b) a mild pancreatic edema accompanies such clinical entities as biliary tract disease, blockage of the lymphatic system and in pneumonitis secondary to cardiovascular disease; (c) that variations in blood amylase activity may be expected in thyroid disease.

Whenever a single determination of blood amylase activity is reported as slightly increased the test should be repeated every day or every other day. In a pancreatitis which is subsiding, remaining stationary or is getting worse there is usually a concomitant decreasing, stationary or increasing blood amylase activity. This statement is based not only upon my own experience but also upon the experience of others notably McCorkle, Goldman and Cornell who made 909 blood amylase activity determinations in 48 cases using the method of Somogyi. They state: "Serum amylase usually parallels the course of the disease and clinical symptoms though the latter may clear before the blood amylase is normal."

When the biliary tract is involved as in Cases 73289, 73303 and 80219 we are no longer surprised to find a slight increase in blood amylase activity since in all 6 of our proved cases of acute pancreatitis there was associated biliary tract disease. This also brings up the question as to whether biliary tract disease causes acute pancreatitis or whether chronic pancreatitis causes biliary tract disease. Weiner analyzed 4000 necropsies and found that "The incidence of gall-bladder disease is significantly increased in pancreatitis but the incidence of pancreatitis in

gall-bladder disease is only slightly if at all higher than in the general autopsy series. Colp, Gerber, and Doubillet state that cholecystitis may be due to pancreatic reflux, and Wolfer has found that pancreatic juice may be the etiologic factor in the production of cholecystitis in the dog. Weiner was able to show that a common channel may exist between the common bile duct and the pancreatic duct without the development of acute hemorrhagic pancreatitis. Our pathologist Dr. A. J. Githitz states that reflux bile *per se* is not always a cause for pancreatitis. In the 2 of our 6 proved cases of acute pancreatitis which came to necropsy no bile was found in the pancreatic ducts and Dr. Githitz states that he has examined postmortem at least 3 other cases of acute hemorrhagic pancreatitis in which no bile was found in the pancreatic ducts.

Dragstedt, Haymond and Ellis have shown that in 60 per cent of the cases of acute hemorrhagic pancreatitis, there was an antecedent biliary tract disease. In 10 per cent of these a common channel was produced by the impaction of gall stones in the ampulla of Vater. In the majority of the remainder, a common channel was produced by spasm of the sphincter of Oddi or edema of the papilla. They state that in cases in which bile is not the etiologic factor then concentration of the alkali of pancreatic juice is the destructive factor just as concentration of acid in the gastrum may be the destructive factor in that location.

Thus a study of the literature makes it apparent that both the 'common channel theory' of bile reflux and the obstructive theory with its concomitant concentration of the alkaline pancreatic juices within the pancreas are both tenable etiologic factors in the production of acute pancreatitis. And the pancreatic reflux theory is a plausible explanation for the high incidence of cholecystitis in pancreatic disease. When these theories are understood and reflected upon, it becomes easier for the clinician to interpret blood amylase activity in biliary tract disease and the need for repeated blood amylase activity determinations in the borderline case becomes more apparent.

Blockage of the lymphatic system may cause an increase in blood amylase activity. In case No. 73653 in which there was a mesenteric cyst about 15 centimeters in diameter and in case No. 74118 in which there were retroperitoneal metastases from an embryonal cell carcinoma of the testes a slightly increased blood amylase activity was found. The mechanism of this increase in blood amylase activity cannot be explained entirely. Shafiroff, Price and Polowe cited by Polowe (14) ligated the thoracic duct and the common bile duct in 1 dog (dog 4). There was an immediate rise in blood amylase activity and this rise was sustained for 48 hours when the dog died. One can only speculate as to whether the ligation of either duct alone would produce this result or whether it takes both conditions combined to do so. The impression at present is that since the lymphatic system is in close communication with the venous system throughout the body lymph with its accompanying enzymes backs up into the general venous circulation when the lymphatics are blocked.

Popper and Necheles cannulated the thoracic ducts in 3 dogs and occluded the portal vein in a 4th dog. They damaged the pancreas in these dogs by the injection of 0.1 to 4 cubic centimeters of bile into the pancreatic duct. They then determined the amylase and lipase activity in the peripheral blood, the portal blood and the lymph. They concluded that the main pathway of pancreatic enzymes into the peripheral blood following injury to the pancreas is by way of the portal vein and to a lesser extent by inflow of enzymes by the lymph of the thoracic duct. Their findings are corroborated clinically by cases Nos. 73653 and 74118 and the slight increased blood amylase activity found with blockage of the lymphatic system and case No. 76131 with superior mesenteric vein and portal vein thrombosis (reported in detail in the fore part of this paper) and its accompanying marked increase in blood amylase activity.

From the foregoing one can readily understand how necessary it is to study the history and clinical findings in each case in order to evaluate properly the blood amylase activity found.

There were 2 cases of pneumonitis secondary to serious cardiovascular disease in group 3. These were Case D M and No 80232.

Case D M a well known surgeon in our community became ill suddenly in 1941. The principal manifestations were pain in the right chest, severe epigastric pain, nausea and vomiting. The patient had had some form of intestinal surgery several years before and this was followed by an incisional hernia. Consultations were held. Roentgenograms of the chest disclosed a right lower lobe pneumonitis. The attending physicians thought that he might be suffering from either high intestinal obstruction or acute pancreatitis. A blood amylase activity test was ordered. Especial care was used in this instance because it was our first serious case in which the cuprous oxide precipitation method was being tried. It was found to be slightly increased ($2\frac{1}{4}$ plus). It was my opinion, given at that time, that this finding was not compatible with an acute pancreatitis but could be compatible with either a pneumonitis or a high intestinal obstruction. The patient's symptoms cleared, and subsequently it was discovered that the patient had a thoracic aneurysm. The patient died suddenly 2 years later when the aneurysm ruptured.

Since acute pancreatitis may simulate coronary thrombosis case No 80232 merits attention.

The patient, a white male aged 52 years was admitted December 22, 1944, and expired January 6, 1945. There was no necropsy. The important manifestations were severe precordial and abdominal pain, dyspnea, pallor, abdominal distention. The final diagnosis was coronary thrombosis with myocardial infarction, but a progress note made the day before the patient died is of interest. January 5, 1945. The first impression was that of myocardial infarction in a heart that already had one incident of thrombosis several years ago. There are several inconsistencies to be explained: (1) Marked ileus (this was present throughout the entire illness and was refractory to treatment); (2) involvement of the upper lobes of both lungs when one expects the lower lobes to be involved in a heart case; (3) bizarre x-ray of the chest exhibiting multiple small deposits throughout both lungs; (4) thick bloody sputum from which were obtained pneumococcus type III, *Staphylococcus albus* and *Streptococcus hemolyticus*. The x-ray findings are not those of pneumonia or infarct, rather they suggest the possibility of carcinoma of the lungs.

It is my opinion that the slightly increased blood amylase activity in this case was due to the superimposed pneumonitis. Increased blood amylase activity in pneumonia has been reported (12, 14, 15). The mechanism is difficult to explain but the following factors

alone or in combination may act to produce this effect in pneumonia: (1) The pneumococcus capsule is a polysaccharide. It is conceivable that this substance which has been labelled 'SSS' (specific soluble substance) may call forth an added amount of amylase in the blood stream. I was unable to prove this (14). (2) There may be pressure by the congested lungs upon the thoracic lymph duct and this may increase the blood amylase activity. (3) The infection itself may involve other organs so that it is conceivable that in pneumonia we may have a mild pancreatic edema which in turn will increase blood amylase activity. The fact remains that in 2 of every 3 cases an increased blood amylase activity was found in pneumonia (14).

Case 79086 with a diagnosis of toxic nodular goiter and diabetes mellitus is of interest because Bartlett has reported a decreased blood amylase activity in thyrotoxicosis, and he believes that such a decrease is indicative of liver damage. This one case showed a slightly increased blood amylase activity, the test being run off with a water control (16) because of the associated diabetes mellitus. Among the many laboratory findings were two basal metabolic rates of plus 79 per cent and plus 92 per cent. Suffice it to state that I am not sure how wise it is to draw any conclusions from blood amylase activity in thyrotoxic disease. The experimental work of Cope and associates on dogs and rabbits produced variations in serum amylase which were not consistent.

Nothing can be said about case No 80300, a white female aged 56 who was admitted December 28, 1944, and who signed her own release January 5, 1945. Her important manifestations were diffuse vague abdominal pain, vomiting, tenderness over the entire abdomen without rigidity, more pronounced in the right hypochondrium. Her blood Wassermann was positive. Her blood amylase activity was slightly increased.

In summing up this analysis of the 9 cases of group 3 in which a slightly increased blood amylase activity was found it appears safe to state that the pancreas is only secondarily and mildly involved in certain clinical ent-

ties. In cases in which it is doubtful as to whether or not the pancreas represents the principal seat of pathology blood amylase activity determinations should be made repeatedly every day or every other day. Ordinarily a careful analysis of the clinical and laboratory findings will lead one to a correct diagnosis.

Group 4. In group 4 there were 7 cases with moderately increased (3 plus) blood amylase activity. These 7 cases represent 10.1 per cent of the 69 patients observed. In every one of the 7 cases the pancreas appeared to be involved. This was proved in 3 instances: case Nos. 72495, 79855, and 82077 which are reported in detail in the fore part of this paper. I was unable to trace Cases F, F and F S so I have considered them as not proved.

Case No. 79627 was studied carefully and a final diagnosis of duodenal ulcer proved by x-ray and other acceptable criteria, was made. Because of the close proximity of the duodenal lesion to the pancreas one should not be surprised to find pancreatitis associated with duodenal ulcer. This patient improved on conservative treatment and her blood amylase activity was then found to be normal. This case and case No. 78148 in group 5 tend to corroborate the findings of Probststein, Wheeler and Gray and those of Goyena and Cipolla who reported increased blood amylase activity in gastroduodenal ulcers. Probststein *et al.* found blood amylase activity normal or subnormal when the lesion was on the anterior wall of the stomach, moderately elevated when it was on the posterior wall of the stomach. They believe that such findings are of value in differentiating such lesions from acute pancreatitis. On the other hand Hinton found blood amylase activity determinations of little value in 40 cases of peptic ulcer and Lewison found the blood amylase activity elevated in only 2 of 25 cases of peptic ulcer.

Case No. 74866 a white male, aged 71 years, was admitted October 3, 1943 and discharged October 6, 1943, improved. The chief manifestations were severe abdominal cramps associated with diarrhea. The onset was sudden, at 2:00 a.m. October 1, 1943. He went to work but had to call a physician at 9:00 a.m. He was sent to the hospital for observation. There was no history of previous medical or surgical diseases. On physical examination his temperature

ranged between 101 and 103 degrees F (38.3-39.4° C). There was marked abdominal tenderness and spasticity in the epigastric and left hypochondriac areas. The clinical impression was acute pancreatitis or perforated viscus. X-ray examination of the abdomen revealed no evidence of intestinal obstruction or ruptured viscus. The blood amylase activity was moderately increased on October 2 (the day of admission), and it was again found moderately increased 3 days later. The patient improved on conservative therapy and was discharged October 6, 1943, 4 days after admission with a final clinical diagnosis of acute pancreatitis.

Of the 3 proved cases of pancreatitis (case Nos. 72495, 79855 and 82077) 2 died. We are thus left with the impression that a moderate increase in blood amylase activity may be associated with a serious prognosis. One should not be surprised that a greater blood amylase activity is not found in acute hemorrhagic pancreatitis. In case No. 79855 there was grossly no viable pancreatic tissue left. In case No. 73196 group 5 only the head of the pancreas exhibited viable pancreatic tissue (see Fig. 2).

The study of these 7 cases in group 4 has led me to believe that a moderate blood amylase activity is almost always associated with pancreatitis of serious import and should be so considered until proved otherwise.

Group 5. In group 5 there were 9 cases with markedly increased (3½ to 4 plus) blood amylase activity (13.1 per cent of the 69 patients observed). Four of these cases (Nos. 73196, 76131, 76645 and 364205) reported in detail in the fore part of this paper were proved at operation or at necropsy.

Case No. 74626 was a white male aged 57 years, who was admitted September 9, 1943 with a chief complaint of pain in the right upper quadrant associated with vomiting. He had had a cholecystectomy 1 year before and was well until the sudden onset of his present illness. His abdomen was very much distended and there were marked tenderness and spasticity in the right upper quadrant. A clinical diagnosis of intestinal obstruction was made. The patient signed his own release the same day but was readmitted the following day, September 10, 1943 with the same complaints plus intense icterus. Among the laboratory findings was found a marked increase in blood amylase activity. A diagnosis of acute pancreatitis was made and the patient improved under conservative therapy. Three days later his blood amylase activity was normal (2 plus). The following day, September 14, the blood amylase

activity was slightly increased. On September 17, the patient had another bout of abdominal pain and vomiting and on that day the *blood amylase activity* was found moderately (3 plus) increased. The patient improved again under conservative treatment and signed his own release on September 20, 1943.

This case demonstrated how well the blood amylase activity parallels the clinical course of acute pancreatitis. There is little doubt in my mind that this was a true case of acute pancreatitis though I have recorded it as an unproved case because operation was not performed and the pancreas, for that reason, was not actually visualized.

Case No. 7562: a white female, aged 66, was admitted December 1, 1943 and discharged December 23, 1943. Improved. Her chief complaint on admission was pain in the stomach for 2 weeks and vomiting for the past 3 days. With the onset of the abdominal pain she suffered a right-sided hemiplegia and developed a severe headache. Her past history disclosed that she had had an attack of gall-bladder colic 6 years before. Otherwise her health had been good. On physical examination her temperature was 100 degrees F (37.8° C.), pulse 108 respirations 24, blood pressure 180 millimeters mercury systolic, 80 millimeters mercury diastolic. Her abdomen was tender in the right upper quadrant. The liver could be palpated a handbreadth below the costal margin. Both lower extremities exhibited ulcers. The reflexes on the right side were hyperactive. The laboratory findings were as follows: Urine—specific gravity 1.019, albumin, negative, sugar 3 plus, a few white blood cells, no red blood cells, no casts, acetone, negative. Icterus index was 20, cholesterol 235 milligrams per cent, white blood cells 11,800, with polymorphonuclear leucocytes 76 per cent, lymphocytes 20 per cent, mononuclear leucocytes 4 per cent, blood sugar 210 milligrams per cent, *blood amylase activity* markedly (4 plus) increased. For one reason or another no attention was paid to the blood amylase activity and a clinical diagnosis was made of acute cholecystitis, mild apoplexy and diabetes mellitus. The patient was treated conservatively though the surgeon who was called in consultation recommended cholecystectomy, his diagnosis being cholecystitis. The patient was discharged, improved, without operation December 22, 1943.

In reviewing this case I cannot escape the impression that the patient's chief complaints were due in part at least, to acute pancreatitis. And I am forced to conclude that a marked degree of blood amylase activity increase is not necessarily related to a serious prognosis. The clinical status of the patient is a far better guide to prognosis.

Case No. 76140 is of interest because the blood amylase activity determinations were made twice on the 7th and 8th days *post operative* to see what it would show. On both occasions the *blood amylase activity* was markedly (3½ plus) increased. The operation was performed January 20, 1944 and consisted of a gastrectomy and splenectomy. The patient developed pneumonia and anuria and expired on January 28, 1944, 8 days after operation.

The patient in this case was a white male, aged 53 years, who had had stomach trouble for the previous 2 years and had lost 25 pounds (11.4 kgm.) in that time. His previous health had been good. The physical examination among other things disclosed a hard nodular mass in the epigastrium, a mitral systolic murmur and marked varicosities in the left popliteal fossa.

At operation the stomach had to be shaved away from the pancreas to which it was strongly adherent. Bleeding occurred at the lower pole of the spleen and it was deemed necessary to remove the spleen along with the stomach.

In reviewing this case one regrets that a blood amylase activity determination was not made prior to operation. So many possibilities present themselves in this case as a cause for the increased blood amylase activity after operation that any one or combination of the following factors could easily have been the responsible factor: (a) injury to the pancreas and spleen; (b) the postoperative pneumonia; (c) the anuria. There was no necropsy. The pathologic diagnosis (by Dr. A. J. Gitlitz) was infiltrating adenocolloid carcinoma of the stomach with carcinomatous lymphangitis and lymph node metastases, mild toxic splenitis.

The seventh case in group 5, a white male, aged 65, was admitted three times in 1944 (history Nos. 77790, 78099, and 79261). On first admission, May 27, 1944, the patient had an incarcerated right inguinal hernia, which was operated upon the same day and he was discharged, recovered, June 14, 1944. On second admission 4 days later, June 8, 1944, he came with a chief complaint of right upper quadrant pain and icterus. An electrocardiogram showed no evidence of a heart lesion and an x-ray film of heart and lungs revealed no lung pathology. The heart was considered normal in size and configuration. The *blood amylase activity* the day after this admission, June 10, 1944, was markedly (4 plus) increased. He was treated conservatively and discharged improved July 11, 1944 with a final diag-

nosis of acute pancreatitis. On third admission, September 24, 1944, a diagnosis of arteriosclerotic heart disease was made. He expired October 27, 1944. Roentgenograms of the chest after lipiodol injection showed no evidence of bronchiectasis. The right dome of the diaphragm was elevated and there was air between the liver and the diaphragm. Examination of the esophagus showed a filling defect at the level of the arch of the aorta and a dilatation proximal to this point. Below the filling defect there was a constriction and the barium trickled slowly past this area. Esophagoscopy was performed by Dr. L. Markowitz, and a portion of the lesion was obtained for biopsy October 24, 1944. The pathologic report was squamous cell carcinoma with pearl formation. The patient expired October 27, 1944. There was no necropsy.

It is my conviction that on the second admission of this patient the diagnosis was acute pancreatitis. I have not considered this a proved case because neither operation nor necropsy was performed and the pancreas for those reasons was not visualized. Once again we note that a marked blood amylase activity need not necessarily spell a serious prognosis with regard to acute pancreatitis. It is the clinical status of the patient, rather than the laboratory aid that is the surest guide to prognosis.

Case No. 78148 in group 5 a white male aged 64 years was admitted June 21, 1944, and discharged July 6, 1944, improved. His chief complaint was right upper quadrant pain which radiated to the left across the abdomen. The pain was of 8 weeks' duration. His temperature ranged between 98.6 and 100.6 degrees F (37.0 and 38.1 C.), pulse 68 to 100 respirations 20 to 24. The laboratory work up included the following: gastrointestinal x-ray revealed duodenal ulcer. The white blood cells numbered 14,050 with stab forms 6 per cent, polymorphonuclear leukocytes 60 per cent, lymphocytes 33 per cent, monocytes 1 per cent, hemoglobin was 16.5 grams per cent. Red blood cells numbered 5,200,000. Blood sugar was 500 milligrams per cent. Nonprotein nitrogen was 26 grams per cent. Urine showed specific gravity 1.045, albumin negative, sugar 3 plus acetone a trace, an occasional white blood cell, no red blood cells, casts none. The blood amylase activity was markedly (4 plus) increased. The patient was treated conservatively by means of a diabetic diet and the injection of protamine zinc insulin. He improved and was discharged July 6, 1944.

Since a water control (16) was not run when the blood amylase activity was determined it is not known how much of the cuprous oxide precipitation was due to the high blood sugar. Experience has taught that

a marked blood amylase activity in diabetic mellitus is not entirely due to the free blood sugar when the cuprous oxide precipitation method is used. In this case there was a proved duodenal ulcer and it is likely that the abdominal pain was due to a mild pancreatitis induced by the nearby duodenal lesion. However one can only speculate about this in this case since a water control was not run to determine how much of the cuprous oxide precipitation was due to the free blood sugar in this severe diabetic. Goyens and Cipolla and others have shown that there is an increased blood amylase activity in some cases of duodenal ulcer. Our 2 cases, case No. 79627 group 4 and case No. 78148 group 5 tend to corroborate these findings.

In summing up on group 5 the conclusion is arrived at that a marked blood amylase activity always indicates involvement of the pancreas but that it does not always indicate that the pancreas is the main seat of the pathology. The outstanding exceptions were in the case of superior mesenteric vein and portal vein thrombosis in duodenal ulcer and in carcinoma of the stomach where the lesion is on the posterior wall adherent to the pancreas. Of the 3 proved cases in which the pancreas was the main seat of the pathology only 1 died. We are thus reminded that a marked blood amylase activity in acute pancreatitis does not necessarily mean a serious prognosis.

In Table I 6 cases of pancreatitis proved at operation or at necropsy have been grouped in order to emphasize the fact that the introduction of a laboratory aid such as the cuprous oxide precipitation test for the determination of blood amylase is fraught with difficulties. In Cases 1 and 4 of this table the test was run after operation after the diagnosis was established. This sort of finding is always anticlimactic. In Case 2 a normal blood amylase activity was found and subsequent operation showed the presence of pancreatitis. This to say the least, is always disappointing in spite of the fact that it is well known that blood amylase tends to decrease to normal when pancreatitis is subsiding and does so rapidly.

In 3 cases the blood amylase activity was determined before operation or before nec

TABLE II—THE PRINCIPAL PATHOLOGY AND BLOOD AMYLASE ACTIVITY IN 69 CASES

Principal pathology	N of cases	Blood amylase activity		
		Normal	De-creased	In-creased
Pancreas				21
Gall bladder	5	20		4
Gastrointestinal	16			4
Esotrophectomal and mesenteric	4			2
Aortic aneurysm				
Thyroid				
Liver	2	7		
Kidneys	2	2		
Fulmonary tuberculosis	1		4	
Miscellaneous	3			
Total	69	37	7	2
%	100	53.6	10	3.3

ropsy and in all 3 (cases Nos. 3, 5 and 6) pancreatitis was found.

Two conclusions have been drawn from this study: (1) When increased blood amylase activity is found pancreatitis should be deemed to exist unless proved otherwise; (2) If one is to make a correct diagnosis of pancreatitis before operation or before necropsy one must be pancreatic disease conscious.

In Table II are given the principal pathology and blood amylase activity in 69 patients. A study of this table has led to the conclusion that multiple pathology is the rule rather than the exception when pancreatitis is part of the picture. In 25 cases (36.3%) there was an increased blood amylase activity. In 7 cases (28% of the 25, 10% of the entire series of 69 cases) the pancreas was the principal seat of pathology as proved at operation or by necropsy.

In only 1 case (3.3%) of the 44 cases in which the blood amylase activity was normal or decreased was a proved pancreatitis found. Thus again I am forced to conclude that a normal or decreased blood amylase activity tends to rule out pancreatitis or that, when it is thought to be present then it is subsiding or has subsided. By the same token, when ever an increased blood amylase activity is found pancreatitis should be deemed to exist

unless proved otherwise. A careful evaluation of all the facts will most surely lead to a correct diagnosis.

In estimating the number of cases in which the test was used to include or exclude pancreatitis the 5 cases of tuberculosis and the 1 case of toxic nodular goiter were not counted. Thus there were 63 cases in which it was sought to include or exclude pancreatitis. Of these a clinical diagnosis of pancreatitis was made in 12 (19%) cases of which 7 (11%) were proved at the time of operation or necropsy.

This is significant. It implies that every patient with upper abdominal pain must be considered suspect with regard to pancreatitis. If one keeps pancreatitis in mind at least 11 proved cases of pancreatitis may be discovered in every 100 patients with upper abdominal pain. And the more cases of pancreatitis that are found the better will be our treatment the better will be our results.

Of the 6 proved cases of pancreatitis 3 patients (50%) died. Of these 2 cases were fulminating affairs. As one reviews the histories in these cases the impression is gained that time is lost in making an accurate diagnosis and that there is as yet no set plan of treatment which has been found uniformly effective. Reflection upon this leads me to suggest that a "pancreatitis team" be formed in each hospital to cope with this problem and that there be a central "pancreatitis registry" where all proved cases of pancreatitis could be filed and made available for study and evaluation of the manifold phases of this truly serious disease.

With the advent of penicillin it is likely that more patients with acute pancreatitis will recover if the diagnosis is made early. But, in the presence of acute hemorrhagic pancreatitis or pancreatic necrosis, it strikes me that only a careful combination of medical and surgical treatment will cut down the mortality rate. I feel reasonably certain that the hospital staff that is pancreatic disease conscious will produce the best end-results.

In the following tabulation have been included the clinical entities in which blood amylase activity has been found to be increased or decreased.

Increased

Decreased

- | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> 1 Acute pancreatitis, trauma of the pancreas and spleen, pancreatic collections (pseudocysts) 2 Pneumonia, in 2 out of every 3 cases 3 Perforation of peptic ulcer into or near the pancreas 4 Duodenal ulcer 5 High intestinal obstruction 6 Salivary duct occlusion, suppuration, or mumps 7 Impaired renal function 8 Superior mesenteric vein and portal vein thrombosis 9 Common bile duct obstruction 10 Adenocarcinoma of the gall bladder 11 Toxic nodular goiter 12 Mesenteric cyst 13 Retroperitoneal metastases 14 Aneurysm of thoracic aorta 15 Adrenal insufficiency in the dog | <ol style="list-style-type: none"> 1 Pernicious anemia 2 Pneumonia and other infections 3 Obstructive jaundice 4 Primary and secondary malignancy of the liver and bile ducts 5 Impaired renal function where there is a great loss of albumin 6 Diabetes mellitus 7 Toxemia of pregnancy 8 Drug poisoning 9 Burns, with liver and loss of plasma protein 10 Acute alcoholic state of the chronic alcoholic 11 Hyperthyroidism with impaired liver function 12 Tuberculosis 13 Hemorrhagic shock 14 Perforation of peptic ulcer anterior gastric wall |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

By and large a careful analysis of any given case will lead one to a correct diagnosis if one keeps pancreatitis in mind. Just the mere fact of thinking about pancreatitis is almost in itself sufficient. The laboratory aids are helpful, indeed, but one should not readily discard his years of clinical experience when a laboratory aid fails to corroborate a clinical impression.

GENERAL COMMENTS

At the beginning of this article it was stated that blood amylase activity determinations have been used with increasing success at our hospital for over 4 years. The cuprous oxide precipitation test itself is truly reliable but its successful evaluation varied at first for one or more of the following reasons:

1 Difficulty was encountered in making the medical staff pancreatic disease conscious. Now however after 4 years the test is being ordered with fair regularity in cases characterized by upper abdominal distress. The greatest comfort is derived when the report is normal or decreased blood amylase activity.

2 Difficulty was encountered in getting the medical staff to realize that while an increased blood amylase activity nearly always

implied pathologic involvement of the pancreas it did not always imply that the principal pathology lay within the pancreas. Thus a marked increase in blood amylase activity has been reported in the pneumonias (12, 14, 15), in duodenal ulcer (6, 18), in acute trauma of the spleen (11) and in mesenteric vein and portal vein thrombosis reported herein. A careful evaluation of the history and physical findings in each case will almost always lead one to a correct diagnosis.

3 Difficulty was encountered in gaining the confidence of the staff in a gross evaluation of blood amylase activity in terms of normal, increased, decreased, or by plus and minus signs. In another article (14) I have gone at length into my reasons for adopting a gross measure of amylase activity. Suffice it to state that after having performed this test more than 500 times, I am more than ever convinced that measurement of blood amylase activity by means of cuprous oxide precipitation is a quick, simple and reliable method. Anyone may perform the test. It does not take highly trained technicians and it requires only the simplest of apparatus.

SUMMARY

1 Moderate to marked blood amylase activity is almost always associated with disease of the pancreas.

2 Normal or decreased blood amylase activity almost always excludes pancreatitis. Where pancreatitis exists in conjunction with a normal or decreased blood amylase activity it may be safely assumed if the clinical status of the patient bears it out that the pancreatitis has subsided or is subsiding.

3 A slightly increased blood amylase activity may be safely regarded as indicating pancreatic involvement secondary to principal pathology elsewhere. When in doubt, tests should be repeated every day or every other day if the condition of the patient permits.

4 The presence of multiple pathology is the rule rather than the exception in acute pancreatitis. Biliary tract disease is the commonest complicating factor in this respect. An attack of acute pancreatitis may be the first clinical sign of the presence of biliary

AMINO ACIDS IN THERAPY OF DISEASE

Parenteral and Oral Administrations Compared

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AMINO acids were tested for their value in the treatment of human disease in the observations presented in this paper. Certain mixtures of those amino acids reported essential for the growth of rats (25) together with the amino acid glycine were given over long periods of time either parenterally or orally. *Parenterally* they were of considerable value (Tables I and III) providing nitrogen balance weight gain and clinical improvement. Similar benefit has been previously shown in man (4) and in dogs (17-20). *Orally* they maintained nitrogen balance (Table II) but in the patient studied they were not quite so well utilized as were natural food proteins.

Nitrogen balance with 8 amino acids has been obtained in normal human beings (26). These 8 are threonine valine leucine isoleucine lysine tryptophane phenylalanine and methionine. The mixtures used in the observations of this paper contain in addition to these 8 amino acids histidine arginine and glycine. It appears in Table I that histidine may be required for nitrogen balance in a patient with chronic ulcerative colitis. In normal man histidine has been omitted and nitrogen balance maintained (26-2).

Parenteral nitrogen feeding in man was first successfully reported only 6 years ago (12). Parenteral feeding is indicated and important in treatment when feeding by the gastrointestinal route is impossible or inadvisable. A very high protein intake with its beneficial results such as obtained by natural diet in the patient of Table IV would be very difficult of achievement by wholly parenteral means. Nor should it be attempted until real efforts to improve the oral intake have failed.

Complete and successful parenteral administration of protein nitrogen, fat, carbohydrate and accessories has been achieved in man (8). The studies here involving parenteral feeding were not intended to provide complete nutrition parenterally. It was desired to test amino acid mixtures given parenterally while optimum quantities of nonprotein dietary constituents were given orally. In most of the observations given in Tables I to III there was some protein present in the diet but in 2 periods presented in Table III the intake was almost exclusively from amino acids.

GENERAL MATERIALS AND METHODS

All metabolism studies were made with the patient in the metabolism division except for the study presented in Table II. Food and fluid net intakes were carefully weighed or measured and their nitrogen contents calculated from standard reference tables. The nitrogen content of some of the diets as noted in the clinical histories was checked by Kjeldahl analysis of a complete day's intake. All urine feces and vomitus were saved for analysis. Stool collection periods were marked by tomato seeds given on the first day of the period. Total nitrogen was done by macro Kjeldahl procedure and urea plus ammonia nitrogen by the method of Van Slyke and Kugel. The patients were weighed under uniform conditions on a special balance and weights at ends of periods noted (see tables).

The amino acid mixtures were somewhat similar to those used in the first patient (4). Mixture designated vuj contained in grams per 100 gram dl threonine 10.8 dl valine 13.8 1(-) leucine 15.4 dl isoleucine 10.8 1(+)-lysine. HCl H₂O 12.3 dl tryptophane 1.8 dl-phenylalanine 6.9 dl-methionine 6.2 1(+)-histidine HCl H₂O 4 1(+)-arginine HCl 8

glycine 10 nitrogen content 13.6 per cent by calculation 13.3 per cent by Kjeldahl. Mixture vu is vuj with the 1(-)-leucine replaced by the same amount of dl leucine. Mixture vu consists of dl threonine 7 dl valine 11 dl leucine 18 dl isoleucine 12 1(+)-lysine. HCl H₂O 12 1(-)-tryptophane 4, dl-phenylalanine 12 dl-methionine 6 1(+)-histidine HCl H₂O 4 1(+)-arginine. HCl 7 glycine 7 nitrogen by calculation 13.1 per cent. Mixture vus is vu with the dl-leucine replaced by 1(-)-leucine 9 gm. Mixture vub is vus with the phenylalanine reduced to 8 grams.

The amino acids were dissolved in distilled water just below the boiling point, filtered, and autoclaved for 15 minutes at 15 pounds pressure. The solutions were water clear often faintly yellowish after autoclaving. They were acid, about pH 5 except as noted.

The amino acids were given intravenously or subcutaneously in 6 to 13 per cent concentration. The concentration and volume of each injection was measured and any small quantities not given because of incomplete drainage of tube or flask were deducted. The vuj, vus, and vub mixtures were usually given in 10 per cent concentration. Mixtures vuk and vu were given usually in 7 per cent solution. The solubility of the different mixtures has largely determined the concentration employed.

ANALYSIS OF DATA

The observations recorded in Table I represent an almost perfect metabolism study of 100 days duration. The patient was intelligent and co-operative, and except for the loss of the fecal output of period 15 the measurements of nitrogen intake and output were complete.

Nitrogen balance and considerable weight gain were obtained during 85 days (periods 2 to 18) when amino acids furnished the bulk of the nitrogen intake—85 to 93 per cent except for periods 3 and 4 of about 80 per cent. Synthetic mixtures of the 10 amino acids essential for the growth of rats (25) and glycine provided this nitrogen, except for period 3 when the protein hydrolysate amigen was given. These amino acid mixtures included unnatural isomers of threonine, valine, isoleucine, tryptophane, phenylalanine and methionine, and in mixture vuk leucine. No toxicity to these unnatural isomers was detected. The amino acid mixtures of period 2 produced clinical disturbances, and nitrogen balance was not obtained (Case 1 first study Table I). Amigen in period 3, however, was well utilized and well tolerated at injection rates below 1.2 milligrams nitrogen per kilogram per minute. In period 4 the mixture vuj was similarly utilized and tolerated. It should be noted that the urinary nitrogen partition is the same with this mixture containing unnatural isomers as with amigen. With either material the undetermined fraction is higher than with oral feeding of natural protein (compare with period 1). A similar difference between intravenous and oral administration of digests to dogs has been found (19).

The oral feeding periods 12 to 14 are of much interest. Nitrogen retention was considerably greater than in the injection periods. This retention was associated with a reduction in the urea and ammonia nitrogen of the urine. In contrast to the observations in dogs (19) there was no decline in the undetermined urinary nitrogen. A rise in fecal nitrogen in periods 12 and 13 tapered off in period 14. An increase in the number of bowel movements also occurred and as detailed in the case report, the number did not return to the previous level until period 17.

Tolerance was good but not strikingly greater for mixture vuj than for amigen in this patient. Better tolerance for other mixtures of amino acids was found in the observations of Table III and in the earlier report in man (4). Better tolerance for other mixtures has also been found in dogs (21, 18). In period 10 two of the intravenous injections were made in 13 per cent concentration, both without reaction or vein injury. The nitrogen rates, however, were only 7.8 milligram per kilogram per minute.

The improved tolerance of the mixture without phenylalanine is quite definite in this patient, as described in Case 1 Table I periods 6 and 7. Omission of histidine, arginine, lysine, or methionine was without noticeable effect on tolerance. Subcutaneous injection of the amino acid mixture in 10 per

TABLE I.—AMINO ACIDS PARENTERALLY WITH NITROGEN BALANCE, WEIGHT GAIN AND CLINICAL IMPROVEMENT

M. E., aged 26 years, chronic ulcerative colitis

Period 5 days	Amino acids	Nitrogen intake per period		Nitrogen output per period				Nitrogen balance per period	Weight
		Food	Amino acids	Urine total	Urine res- NH ₂	Urine non- ionized	Feces		
		Grams	Grams	Grams	Per cent	Grams	Grams	Grams	Kilograms 52.20
	None	5		40.5	8	0.3	29.7	+ 2	52.00
	Valine, l.	0.5	65	65.2	7	0.0	26.5	- 20.2	50.22
3	Amigen, l.v.	5	6.6	56.6	67	18.0	5	+ 8.7	52.63
4	Val, l.v.	22	29.0	55.7	69	7.4	14.7	+ 4.7	54
5	V. l. l. s.c.	7.5	02	63.4	73	5.5	8.7	- 6	52.18
6	V. l. l. v. c.	12.0	21.6	52.4	66	2.5	13.6	+ 3.5	54.43
7	Val, l.		64	80.0	70	24	0	+ 6.0	52.43
8	Val, l.v.	7.4	22.0	76	85	24.5	12.0	+ 2	54.63
9	Val, l.	0.0	42	44.5	6	7.3	12.7	- 8	55.0
	Val, l.v.	0.0	48	27	60	14.0	13.8	- 0.8	57.0
	Val, c.	0.0	43.2	26.4	65	2.8	12	+ 0.5	58.0
	Val, oral	0.0	42.2	5	49	7	17	+ 5	58.8
11	Val, oral	0.0	43.2	27.7	49	2.4	6	+ 0.4	60.00
12	Val, oral	0.0	42.5	27.4	45	14.2	12.8	+ 9	60.82
13	Val, l.v.	0.0	42.5	28	63	24	lost		60.25
16	Val valine histidine l.v.	0.0	40.7	27.2	63	12.0	5	- 2.2	60.78
17	Val valine histidine l.v.	0.0	40.7	41	66	4	7	- 5	60.47
18	Val, l.	0.0	42	26	6	4		+ 8	61
19	None	10.2		6.7	25	0	7.5	+ 2.2	62.20
20	None	01.2		69	87	5.1	5	+ 2	63

cent concentration during periods 5, 6 and 11 produced no disturbance and utilization was equal to that following intravenous injection (compare periods 10 and 11). It should be noted that this patient was an ambulatory sensitive individual to whom these hypodermoclyses were no more uncomfortable than if physiological saline solution were being injected.

Improvement in clinical condition was evident by period 3 and continued throughout the study. The underlying disease was by no means cured but its signs and symptoms were greatly alleviated. The number of bowel movements declined from 5 to 6 daily to 3 daily after only 5 days of parenteral nitrogen feeding. They were reduced to only 1 daily after period 6. Marked reduction of fecal nitrogen output was of equal interest (compare

periods 1 and 6). Symptoms of abdominal distention also disappeared. Similar clinical improvement has been observed in another patient with chronic ulcerative colitis when given amigen intravenously and a high carbohydrate low protein diet orally. Some of the clinical improvement in these cases may be due to the mental comfort of 'special treatment,' but probably not all of it.

Omission of histidine was associated during the second 5 days (period 17) with a rise in urinary nitrogen. Nitrogen balance was negative but it should be noted that nitrogen intake was less by the amount of the histidine nitrogen. We believe however that the rise in urinary nitrogen during histidine omission and its prompt return to the previous level upon histidine replacement indicates a requirement for histidine by this patient.

Weight increased steadily particularly after period 7 and even during histidine omission. Nitrogen retention over the entire period of amino acid administration does not total enough to account for the large gain. Deposit of fat probably explains most of the increase. Weight increase continued without interruption when a natural diet was given during periods 19 and 20 now with large deposits of nitrogen, and the reduction in undetermined urinary nitrogen was striking.

CASE 1: First study M. E. (SMH 203 158) was a 26 year old white painter with ulcerative colitis of 6 months duration when the observations presented in Table I began. Two months previously he had left the hospital after a stay of 6 weeks. During this first admission no cause could be found for the colitis. Upon fluoroscopy the colon appeared large and its wall smooth. Upon sigmoidoscopy it showed many fine bleeding points but no distinct ulceration. Stools were 7 to 8 daily a reddish liquid, half red blood cells and half leucocytes upon microscopic examination, but during bed rest, high protein and vitamin intakes, blood transfusions, and sulfasuccidine therapy the number of bowel movements decreased to 3 to 4 per day. Out of the hospital some of this improvement was lost and the weight had declined from 58 to 53 kilograms. Upon the present (second) hospital admission it was suggested that a very low residue diet might be advantageous. After 6 days of routine care in the hospital the patient was transferred to the metabolism division. He remained ambulatory on the division throughout his stay.

In period 1 a soft "low residue" diet of natural foods was consumed. It provided daily protein 127 grams and calories 3104. The same diet was eaten during the last 2 periods (19 and 20) but during the intervening 17 periods a very low protein diet was given. The low protein diet varied somewhat until the eighth period and thereafter remained fairly constant. For the 10 periods (9 to 18) it consisted in grams, of orange juice 400, grapefruit juice 200, lemon juice 70, currant jelly 50, gum drops 300, sucrose 50, dextrose 235, corn starch 200, tapioca 10, cocoa 5, butter fat 40, cream (butter fat 36 per cent) 50, salt 2, baking powder 5. A corn starch-butter fat tapioca "biscuit" was baked and corn starch-cream-fruit juice puddings were frozen. This diet contained by Kjeldahl analysis 138 grams nitrogen and a calculated 3700 calories.

The actual caloric intake of the second period averaged 1977 including the amino acids and of periods 3 to 7 varied between 3,300 and 3,500 including the calories from the amino acids (calculated as nitrogen $\times 15$). A vitamin B complex concentrate was given during the first 7 periods and thereafter a multiple vitamin emulsion (10 c.c. daily) described elsewhere (16). Sulfasuccidine 12 grams, ferrous

sulfate 0.5 gram, and intramuscular liver extract (1 unit per c.c.) 2 cubic centimeters were all given daily during periods 8 to 20. On the bare possibility that insulin might encourage the appetite for the high carbohydrate diet 10 units was given 30 minutes before each meal beginning in period 8. The diet was fairly readily eaten.

During periods 2 to 18 amino acids were given as recorded in Table I. They were injected twice daily through period 8 and once thereafter.

In period 2 mixture vu6 (vub with di-tryptophane) was first given, 45 grams in 30 minutes, and the patient became nauseated. He vomited during the next injection of 87 grams. The vu mixture, used at rapid rates without reaction in the observations of Table III, was then given, 50 grams in 105 minutes (1.5 mgm. nitrogen per kilogram per minute) without nausea and in 85 minutes (1.5 mgm. nitrogen per kilogram per minute) with nausea and vomiting. Nausea twice and vomiting once occurred with 3 of the remaining 6 injections. Vomitus nitrogen 1.5 grams was deducted from the intake in Table I.

In period 3 amigen (an enzymatic digest of casein and pork pancreas) in 5 per cent solution with 5 per cent dextrose was used. A total of 10.43 liters was given in 10 injections, the injections varying from 100 to 200 minutes in length. Only the one at 100 minutes (1.5 mgm. nitrogen per kilogram per minute) produced nausea.

In period 4 mixture vu7 was given in approximately the same quantities (in 65 to 190 minutes per injection) with nausea on 2 occasions at 2.7 milligrams nitrogen per kilogram per minute. Dextrose, 5 per cent, was included in the amino acid solution during the period for more exact comparison with the amigen of period 3. During periods 4 to 6, the amino acid solution was adjusted to a pH of 6.5 by addition of sodium hydroxide—with no apparent effect on tolerance.

On each of the first 3 days of period 5 the large quantity of 105 grams vu7 mixture was given with vomiting during 3 of the 6 injections. Omission of lysine, histidine and arginine during one of these did not prevent vomiting. The amount given was reduced to half on the last 2 days omission of methionine on 1 day did not prevent vomiting. These omissions of essential amino acids were associated with a weight loss from 54.12 kilograms at the beginning of the period to 53.18 kilograms at the end. Vomitus nitrogen of 3.5 grams was deducted from the intake in Table I.

In periods 6 and 7 mixture vu7 65 grams, was injected twice daily usually once by vein and once subcutaneously. There was nausea on 2 occasions but usually no disturbance occurred when the rate was near 1 milligram nitrogen per kilogram per minute. On the last day of period 6 phenylalanine was omitted from both injections (by vein). There was no reaction to the injections given in 95 and 55 minutes, respectively, (1.5 and 2.6 mgm. nitrogen per kilogram per minute). The day's intake of phenylalanine when started 45 minutes after com-

TABLE II—AMINO ACIDS ORALLY COMPARED WITH AMIGEN AND WHOLE EGG

M. E., aged 26 years, chronic ulcerative colitis

Period in days	Diet	Nitrogen intake per period		Nitrogen output per period				Nitrogen balance per period	Weight
		Amino acids	Basal	Urine (total)	Urine urea-NH ₂	Urine non- biureted	Feces		
1	V I	Grams 85.6	Grams 5	Grams 8.3	Per cent 72	Grams 5	Grams 37.9	Grams - 8.3	Kilograms 55.6
	VaI	86.6	5	13.3	65	8.6	13.7	+ 6	50.3
2	VaI	86.6	5	14	64	0.6	15.3	+	50.5
3	Amigen	90	5	47.7	75		4.3	+6	50.8
4	Amigen	126	5	6.0	78	14	65	+1	50.5
6	Egg		87.9	40.6	73	11	37.6	- 1	50.0

pletion of the second injection produced nausea at a rate of 0.6 milligram nitrogen per kilogram per minute.

When the mixture was given the next day (first day of period 7) with phenylalanine included vomiting occurred at a total nitrogen rate of 1.7 milligrams per kilogram per minute phenylalanine nitrogen rate of 0.08 milligram per kilogram per minute. The next day mixture was subcutaneously at 2.9 milligrams total nitrogen per kilogram per minute was followed by vomiting 45 minutes later. When phenylalanine was again omitted on the third day of period 7 the two injections (4 hours apart) were given by vein at 4.3 and 3.1 milligrams nitrogen per kilogram per minute without nausea or vomiting. The phenylalanine given 30 minutes after the second injection produced vomiting at the nitrogen rate of 0.3 milligram per kilogram per minute when 10.8 milligrams phenylalanine nitrogen per kilogram had been injected. The next day no reaction occurred to the complete mixture at 1.1 milligrams nitrogen per kilogram per minute, but 30 minutes after subcutaneous injection of the second dose at 5.6 milligrams nitrogen per kilogram per minute vomiting occurred. The vomitus nitrogen for period 7 amounted to 2.07 grams.

In period 8 the mixture was changed to yuk at the same intake level as in periods 6 and 7. No nausea or vomiting occurred at the slow rates of 0.7 to 0.9 milligram nitrogen per kilogram per minute.

In periods 9 to 11 the amino acid intake level was reduced to half that of period 8 and injections were usually at the same slow rates even when given subcutaneously (period 11). At the end of period 9 and during part of period 10 the patient had for 3 days a sore, red pharynx and fever to 39.5 degrees C. It subsided uneventfully. Cultures were nonspecific.

In periods 12 to 14 the amino acids were given by mouth, the 10 per cent solution being mixed in the fruit juices and frozen puddings. After the first 2 days the patient stated that the taste was not unpleasant.

In period 15 the stool collection was accidentally discarded. Periods 16 to 20 were uneventful.

The patient's symptoms of abdominal discomfort subsided entirely during the early periods. The number of bowel movements decreased sharply during periods 1 to 7 the numbers per period being 27, 30, 17, 13, 10, 13, and 4, respectively. There was one stool a day during periods 8 to 11 but when the amino acids were given orally in periods 12 to 14 the numbers per period were 10, 9, and 8 respectively. During periods 15 to 18 the number declined again 9, 7, 5, 6 and in periods 19 and 20 on the same diet as period 1 were 3 only during each period. The stools did not become formed until the last two periods, and, although no blood or mucus was visible still did not appear normal.

During the first 7 periods the plasma protein level rose from the region of 5.7 to the region of 6.3 grams per 100 cubic centimeters of plasma and remained there during the remaining periods except for dips to 5.8 during periods 10 and 11. The albumin/globulin ratio remained about 1.7 most of the time. The serum nonprotein nitrogen, chlorides, and plasma carbon dioxide combining power varied within normal ranges. The hemoglobin rose from 11.1 to 13.2 grams while the red cell count remained at 4,200,000.

At the end of the study fluoroscopy showed improvement of the colon as compared with its appearance at the beginning of the study. Sigmoidoscopy however still showed bleeding points and excessive secretion in a reddened edematous mucosa. No ulcers were seen. The patient was discharged to work as a hospital orderly to be kept under observation. Subjectively and objectively he was temporarily greatly improved (Case 1, Table II).

In Table II the effects on nitrogen metabolism of giving amino acids and amigen by mouth are shown. The salutary effect on the symptoms of colitis in the observations of Table I suggested that an attempt to relieve these symptoms which had recurred should be made by oral administration of the amino acids. The symptoms were not relieved (Case

1 second study Table II) but the observations are of interest.

The amino acids appear in this instance to be better tolerated by the intestine than amigen but amigen appears better utilized upon absorption from the intestine. These factors combine to yield approximately the same net retention of nitrogen in periods 2 to 5. The negative balance of period 1 probably reflects the change from the higher level of nitrogen intake which probably preceded the relatively low level of period 1.

The egg nitrogen of period 6 Table II is better utilized than either the amigen or the amino acids, as judged by the relation of intake to urinary output, but the loss through the intestine offsets this advantage.

The weight remained fairly constant through out the observations (Table II). The gain registered in Table I on similar intakes did not occur here probably partly because of increased caloric demand during activity out side of the hospital.

CASE 1: Second study M. E. (SMH 203 158) was the same patient studied in the observations recorded in Table I. He worked for 1 week upon discharge from the hospital, then his old symptoms began to return gradually. Within 3 weeks he was having 8 to 9 bowel movements a day and soon had an acute febrile exacerbation. This gradually subsided during hospitalization and vigorous supportive therapy. During the first 2 months of this relapse his weight had declined to 47.6 kilograms but rose to 52 kilograms upon discharge from the hospital 3 weeks later. During the next 2 months he gained weight despite continuance of frequent loose stools.

As a co-operative out-patient he was eager to test the influence of the low residue diet again with amino acids by mouth, so that the conduct of the experiment was entirely satisfactory. The amino acids were weighed in the laboratory and the basal diet was weighed on a special balance at home. The basal diet for the entire 6 periods was identical with that of periods 9 to 18 (Table I) except for omission of the cream and the cocoa. It had a daily nitrogen content of 0.5 gram. The vitamin emulsion used was the same as that in the observations recorded in Table I. Urine was collected in 2 day periods under toluene with refrigeration, and analyzed the following day. Stools were collected in 10 day periods. The weight at the beginning of period 1 was 58.6 kilograms.

In periods 1 to 3 the amino acid mixture and the diet were completely consumed. Vomitus nitrogen the first day of period 1 was deducted from the intake. The acids without methionine were fairly innocuous to the palate, so that the patient took the

methionine separately "as medicine," in divided doses to accompany the three meals a day.

In periods 4 and 5 amigen powder was dissolved and suspended in the diet, 75 grams daily in period 4, 100 grams in period 5 with 150 grams on the first day. It was tolerated although less palatable than the crystalline amino acids. An exacerbation of symptoms with abdominal pain and increased tenesmus and bleeding occurred during the last 2 days of period 4 and the first of period 5. Sulfanacide was then given for 6 days, and although the diarrhea increased for 4 days the other symptoms subsided.

The symptoms of colitis continued without relief during the 60 days of these observations. In fact the number of bowel movements rose from 8 to 10 daily prior to period 1 to 11 to 14 daily during period 1 totalling 120. During periods 2 to 6 the totals were 98, 111, 114, 145 and 124 respectively. The stools contained much mucus, and frequently blood.

In period 6 the protein intake came from 1 pound of hens' eggs daily (12 ounces on the first day). The nitrogen of the total diet of 1 day was determined by Kjeldahl analysis. On the fourth day of the period the patient had a transient upset and vomited once, nitrogen content 1.18 grams. He had lost his appetite for this stringent regimen by the close of the period and returned to his soft, more varied diet.

Table III further demonstrates the value in preoperative and postoperative care of parenteral feeding with amino acids. The patient J.S. with chronic intestinal obstruction was maintained in positive nitrogen balance by intravenous and subcutaneous injection of amino acids, despite an intercurrent acute infection during periods 1 and 2. Moreover during period 1 the nitrogen intake was entirely from amino acids except for 0.6 gram on 1 day only.

When no amino acids were given during period 4 the patient was unable to maintain adequate nutrition by mouth. Operation on the last day of this period corrected the obstruction (Cases 2 and 3 Table III).

Postoperatively J.S. (period 5) had an uneventful course and recovered rapidly. Nitrogen balance was maintained despite the serious injury of a major operation. The day-by-day balances of period 5 if one assumes equal division of fecal nitrogen, were +3.0, 0.4, 1.9, +2.4, and +2.7 grams, respectively. This is not the usual postoperative course of the nitrogen balance (10, 7, 15) but allowance must be made for the fact that the patient was emaciated. With zero intake of nitrogen the balance will obviously be negative in any case.

TABLE III—AMINO ACIDS PARENTERALLY YIELD NITROGEN BALANCE AS SOLE SOURCE OF NITROGEN

J S aged 1 year, chronic ileitis

Period days	Amino acids	Nitrogen intake per period		Nitrogen output per period				Nitrogen balance* per period	Weight
		Amino acids gms	Basal gms	Urine Total gms	Urine urea-NH ₂ Per cent 57	Urine amide- nitrogen gms	Feces gms		
	Vu, iv ac	50	3.4	64.7	60	3.8	3.8	- 9	
	Vu, iv ac	65	3.4	64.7	60	3.8	3.8	- 9	28.0
3	Vu, iv	62.3	8.3	34	57	0	8	+6.0	
4	Nose (Operation)		6.5+	7	76	5.4			37
5	Vu, iv	0.7		8	6	3.9	8	+5.8	
6	Nose		7.3	9.6	79	6.6	3	+36.4	37

H S, aged 25 years, carcinoma of head of pancreas

	Vu, iv ac	50		66.4	56	6.3	6.7	-14.8	60.4
	Vub, ac	58.3		3.3	68	10.7	8.3	- 8	

*Grosses of vomitus and Wangenstein drainage deducted

If the nutrition is relatively normal preoperatively the balance will be markedly negative postoperatively. If the patient is protein depleted before operation the negative balance is much less (6). With moderate caloric and protein (or amino acid equivalent) intake balance can be maintained in such depleted individuals, as demonstrated in the present instance. Previously normal individuals require larger intakes of nitrogen, or possibly special kinds of nitrogen (18-9).

Patient H.S. Table III presented the difficult problem of nutrition in a jaundiced patient after a major operation. Anorexia and vomiting were severe and the superficial veins were very difficult to use for injection purposes. All but 2 of the 20 injections during the 10 days of study were made subcutaneously. Tolerance was good to the 10 per cent amino acids subcutaneously and on 2 occasions injections of more than 12 per cent concentration were given in period 1 without the slightest upset.

Nitrogen balance was approximated in the 2nd period with patient H.S. Table III when the entire nitrogen intake was being provided by amino acids. The undetermined urinary nitrogen fraction was proportionately lower with mixtures vu_a and vu_b (as well as with vu_j Table I) than with vu. This may be in direct evidence of poor utilization of the

unnatural d(+)-leucine contained in the vu mixture. Some conversion of d(+)-leucine into the l(-) form occurs in rats (23).

CASE 2. J.S. (SMH 199516) was a 21 year old, white college student with recurrent episodes of abdominal pain and vomiting during the past 7 years. He was emaciated and pale, weight 35.5 kilograms, height 175 centimeters. He had never shaved but his sexual development appeared normal. Fluoroscopy following barium showed several dilations of ileum which were followed by an apparent obstruction.

To attempt to improve the condition of the patient before operation he was transferred to the metabolism division 4 days prior to period 1. Table III for special diet control. Further oral feeding was tried the first 3 days on the metabolism division but vomiting of large amounts of fluid and food occurred every evening. The weight was raised to 37.4 kilograms 2 days before period 1 began largely by retention of saline infusions. A Miller Abbott tube was passed into the jejunum the day before period 1 and distention was relieved but vomiting of ingested food and fluid persisted. An aphthous stomatitis, pharyngitis, and esophagitis began the day before the tube was passed and continued during periods 1 and 2.

In period 1 the amino acid mixture vu_a 200 grams was given daily and the caloric and vitamin intakes were provided by a fortified lemonade and synthetic vitamins and concentrates. There was no clinical disturbance which could be attributed to the amino acids. Fever between 38 and 39.5 degrees C accompanied the stomatitis and near the end of the period an area of patchy density by x ray was found in the right lower lobe. Sulfadiazine was given with questionable benefit.

The average daily caloric intake was 1,800. Other pertinent laboratory data were plasma protein 4.0 grams per 100 cubic centimeters plasma, nonprotein nitrogen 23 milligrams per 100 cubic centimeters serum chlorides 107 milliequivalents per 100 cubic centimeters serum, carbon dioxide combining power 41 volumes per 100 cubic centimeters plasma, hemoglobin 9.5 grams per 100 cubic centimeters blood, leucocyte count 8,600 per cubic millimeter blood. The nitrogen in the vomitus and Wangenstein drainage amounted to 2.6 grams.

In period 2 the amino acid solution was modified on one day by addition of sodium carbonate of sodium content chemically equivalent to the chloride content of the amino acids. The resulting solution had a reaction of pH 8.45 and after subcutaneous injection of 100 grams amino acids in 1600 cubic centimeter solution the patient's thighs were sore and reddened and a small blister appeared at the site of the needle puncture. This irritation subsided without further progression. All other injections at the usual acid pH 5 produced no disturbance. The daily food and amino acid intake averaged 1,605 calories. The small amount of protein came from a processed vegetable soup butter and cream, and tapioca. The remaining diet consisted of fruit juices, sucrose, lactose and corn starch. There was no vomiting. Laboratory data did not change significantly.

Throughout period 3 the amino acids were given intravenously without reaction. The plasma nitrogen given, totalling 5.83 grams, and the red cell nitrogen, 19.35 grams, are not included in the nitrogen intake of period 3 Table III. The patient's general condition showed much improvement by this period. The caloric intake averaged 3,623 but on the last day he vomited a large amount of fluid and food nitrogen content 1.17 grams. Before the first transfusion the total protein of the plasma was 3.8 grams per 100 cubic centimeters after the second transfusion it was 4.8 grams per 100 cubic centimeter. There was no edema at any time. The albumin globulin ratio was 1:5.

In period 4 the patient was tested again on voluntary feeding. He complained of fullness after moderate intakes on the first 2 days and vomited on the third day 128 grams nitrogen including gastric washings from a Levine tube which was then inserted. Food intake was very poor on the third and fourth days and not accurately known. On the fifth day his abdomen was opened under general anesthesia and chronic intestinal obstruction was found due to chronic inflammation of lower jejunum and upper ileum beginning about 2 feet distal to the ligament of Treitz. A segment of ileum about 12 inches long was resected and a side-to-side anastomosis done. The specimen showed 3 greatly narrowed thick walled areas with intervening dilatations as much as 7.5 centimeters in diameter. The mucosa was ulcerated and microscopically there was a non-specific acute and chronic inflammation. The picture was not thought to be entirely like that of regional

enteritis. The patient withstood the operation well. A liter of normal saline was given under the skin. Sulfathiazole was placed in the wound and sodium sulfadiazine was given intravenously for 3 days postoperatively. The day before operation the plasma protein level was 3.5 grams per 100 cubic centimeters. The stool collection for this period was accidentally discarded without nitrogen analysis.

In period 5 amino acids 200 grams daily were given for the first 3 days and 100 grams thereafter. Sodium lactate chemically equivalent to the chloride content was given with the amino acids. The patient had an afebrile postoperative period except for a rise to 37.9 degrees C. on the day after operation. He took clear fluids moderately well for the first 3 days postoperatively and then increased to a diet similar to the preoperative one. The caloric intake averaged 1,542 calories daily being 2,550 on the last day. On this fifth day he complained of feeling queer midway during the first injection of amino acids (50 gm. in 150 minutes) and again about 2 minutes after the second injection (50 gm. in 6 minutes). He could not describe the feeling except that there seemed to be a sense of fullness of the abdomen. The plasma protein concentration rose from 4.5 at the end of the second postoperative day to 5.4 grams per 100 cubic centimeter at the end of the fifth day after operation.

In the sixth period the amino acids were discontinued and diet was changed to include steak, milk eggs, and other foods totalling 18.8 grams nitrogen and 3,310 calories per day but was less than two thirds consumed the first 3 days. General condition and appetite continued to improve. Total plasma proteins at the close of the period were 5.9 grams per 100 cubic centimeters.

The metabolic study was continued for 8 periods beyond those of Table III with the same diet intake with and without testosterone and has been reported elsewhere (3). Nitrogen retention was great and at the end of the 40 days the weight was 49 kilograms.

CASE 3. H.S. (SMH 203 122) was a white female aged 53 years, with obstructive jaundice. At operation the gall bladder and common duct were distended with stones and white bile and a hard nodule was palpated in the head of the pancreas. After cholecystogastrostomy the icterus subsided very slowly the wound drainage was bile stained and the patient's general condition and food intake were very poor. Thirty days later another exploration revealed that the common duct wound had broken down and the cholecystogastrostomy had closed. Cholecystojejunostomy was performed with the patient in and out of shock. Food and fluid intake after operation were very poor for 3 days. There was much vomiting. The patient's veins were poor for intravenous work. On the third postoperative day amino acid feeding was begun. At this time the plasma protein concentration was 4.8 grams per 100 cubic centimeters, plasma albumin 3.0 grams per 100 cubic centimeters, serum chlorides 100 mill

TABLE IV—HIGH PROTEIN FEEDING INFLUENCES RAPID HEALING OF CHRONIC WOUND

O. M., aged 8 years, unhealed burn, duration 1 year

Period (days)	Clinical remarks	Nitrogen intake per period	Nitrogen output per period				Nitrogen balance* per period	Weight
			Urine Total	Urine urea-NH ₃	Urine acid- termed	Feces		
1	Black grafts	Grams 84	Grams 55.6	Per cent 87	Grams 7.0	Grams 4	Grams +24	Kilograms 0
	Two grafts	04	50	86	8.3		+15	
3	Black grafts	80	51.6*	87	6.8	9	+3	
4		97	55.6*	87	7.4	4.8	+16	5
5		07	63.0*	8	6	7	+	
6	Split grafts	30	50.4	83	8.7	3.4		
7		80	57*	86	7	6.4	+10	22.3
8		07	67*	83	8	10.7	+24	

*Calculations—balance estimated.

equivalents per 100 cubic centimeters icterus index 35.

In period 1 amino acids were given subcutaneously twice daily except for 3 intravenous injections. The alone intake was poor as the patient tended to vomit when anything accumulated in the stomach, and the net intake may be estimated at not over 500 calories per day including amino acids. No nausea or vomiting or other reaction was observed in relation to the amino acid injections. The entire food intake consisted of orange juice and lemonade fortified with sugar and on 1 occasion a little tomato juice. The vomitus nitrogen amounted to 1.15 grams. Three plasma and 1 whole blood transfusions were given and their nitrogen content (about 25 gm.) is not included in the intake of period 1. The patient had considerably improved in clinical condition and subjective appraisal of life by the end of the period. The plasma protein total was now (last day of period) 6.4 grams per 100 cubic centimeters and the plasma albumin 3.3 grams, the icterus index 16 and the serum chlorides 103 milliequivalents per 100 cubic centimeters.

In period 2 amino acids were given entirely subcutaneously and the patient, now more alert and co-operative, retained daily an estimated total of 1600 calories, after deducting for loss in vomitus. Vomitus nitrogen amounted to 1.51 grams. The effect of the plasma transfusions was not sustained and the level of plasma protein declined 24 hours later to 5.0 grams per 100 cubic centimeters (first day of period 3).

A liquid diet was given after period 3 and the patient slowly but steadily improved and left the hospital. She returned 10 months after the observation of Table III and died in the hospital. At autopsy carcinoma of head of pancreas was found.

The study in Table IV is presented in this report because of the importance of the thera-

peutic principles it emphasizes. Chiefly these are that a high protein intake may shorten illness and save lives, and second that the best source of a high protein intake is a diet of natural foods—useful and spectacular though parenteral feeding may be.

The patient in this case had been treated in two hospitals for an entire 12 months (See Case 4 Table IV). She had been treated competently in all respects except for control of diet. Good diets had probably been ordered but no measurement of actual intake had been made. The plasma protein level was not regarded as low but it was suggested by those in charge of the case after 1 month in the second hospital that parenteral feeding with amino acids might build up the patient enough for grafts to take and grow.

There was no barrier in the patient to normal eating except lack of appetite for the routine diet. Therefore oral feeding not parenteral was indicated. The diet prescribed on the metabolism division catered to the child's taste and the intake was measured.

Within 2 months from the beginning of Table IV virtually complete healing was accomplished of what had resisted all previous treatment during 10 months. We do not mean to imply that the very high level of protein feeding used in this case (5 to 6 gm protein per kilo) was absolutely essential to its success. A somewhat lower intake might have succeeded though probably less rapidly.

Voluntary uncontrolled intake was not sufficient.

Attention should be directed to the *plasma protein level*. The total plasma protein was nearly 6 grams per 100 cubic centimeters at the beginning of Table IV. Yet the body was unable to mobilize enough protein to produce tissue to anchor skin grafts. Evidently the body was thoroughly depleted of protein even though the circulating plasma protein level was at the lower edge of the normal range. After high protein feeding with much protein being produced and retained the circulating plasma protein level was 7 grams per 100 cubic centimeters or higher. Such an observation suggests that a plasma protein level of 6 grams per 100 cubic centimeters may correlate with a poorer state of health than higher levels within the normal range.

The nitrogen balance data in Table IV are only approximately accurate in that intake was calculated from standard diet tables rather than actual chemical determination and output was not always completely measured on account of incontinence. In addition nitrogen loss from the wound surface was not continuously measured. There can be no doubt, however, that the balance was strongly positive in all periods except the 6th and the rapid clinical improvement and weight gain eloquently confirm the value of the treatment.

CASE 4. O.M. (SMH 213 143) was a thin white girl of 8 years with an unhealed burn of her right thigh and leg. One year and 11 days before the beginning of the observations of Table IV she sustained a burn, largely 3rd degree, from a fire started in bed by a faulty electric heating pad. Four days later she was taken to an adjacent hospital. Infection was treated with sulfonamides.

Three months after the burn pinch grafts were applied unsuccessfully. They were tried again a month later still unsuccessfully. Eight months after the burn the granulating area was considered safe again but the patient went into shock under the anesthesia before the grafts could be taken and applied. Plasma applications were made locally and more sulfonamide therapy was given locally. Ten months after the burn the patient was transferred to this hospital.

On admission she was thin and pale and 70 per cent of the surface of her right lower extremity was a pink wet granulation tissue devoid of skin. There was a 15 degree contracture at the knee. The plasma proteins were 6.36 grams per 100 cubic centimeter by refractometer and the other routine laboratory

tests appeared normal. A high protein high vitamin diet was ordered and as much assistance was given her with eating as could be spared on a busy pediatric division. She ate fairly well.

During the first month she had an upper respiratory infection and some intermittent fever possibly related to wound infection. Measurement of the nitrogen loss from the granulating surface was done by determining the nitrogen content of the dressings with correction by deducting the small nitrogen content of equivalent unused dressings. The measured loss was 1.06 grams nitrogen per day. Five weeks after admission, large split thickness skin grafts were applied with thrombin technique by Dr. Forrest Young. They did not take.

The reason for the failure of the grafts was not apparent. Infection was controlled. The plasma protein level was above 6 grams per 100 cubic centimeters and although thin the patient was eating and did not appear emaciated. It was, however, considered desirable to improve the nutritional status and a request for amino acid injections was made. The patient was transferred to the metabolism division. Since the patient was co-operative and could eat normally it was decided to urge the complete consumption of a measured high protein diet. Foods were selected according to the tastes of the patient. The diet was accurately weighed and net consumption carefully measured. Vitamin supplements were continued exactly as during the preceding 3 months. These were ascorbic acid 50 milligrams, brewer's yeast tablets 15 grams and oleum percomorph 1.0 milliliter daily.

At the beginning of period 1 the patient weighed 19.18 kilograms including wet dressings. The plasma protein level was 5.90 grams per 100 cubic centimeters (by macro-bioklinal analysis) the plasma albumin 3.70 grams per 100 cubic centimeters. The plasma chlorides and carbon dioxide combining power were normal. There was no evidence of dehydration. Seven days before the beginning of period 1 about 12 pinch grafts were applied.

The diet contained in grams: milk 800, whole egg 100, lean ham 100, frankfurter 100, lean ground beef 100, bacon 30, American cheese 50, frozen fresh peas 50, dried prunes 50, white bread 50, butter 30, sugar 30, cocoa 15. The diet is calculated to contain about 132 grams protein and 2360 calories, with roughly equal weights of protein, carbohydrate, and fat. For a patient of 19 kilograms it provides 6.9 grams protein and 124 calories per kilogram, as much as required by a newborn infant. The diet was not given in its entirety as listed, during any complete 5 day period. The patient ate very well, and usually most of the day. Some modifications were made and on some days portions of the diet were not eaten. All of these were weighed back and deducted from the net intake. The net intake for example, of period 1 was above 6 grams protein per kilogram. Urinary nitrogen outputs were determined in 24 hour periods, fecal nitrogen in 5 day periods.

In period 2 it was strikingly evident that the recent pinch grafts were taking. In addition spreading of new epithelium could be seen about some old grafts which had previously been buried by granulation tissue. The food intake continued high despite the occurrence of acute tonsillitis with fever.

More pinch grafts were applied in period 3 and as these grew and the patient's weight and strength improved markedly in periods 4 and 5 it was decided to cover the whole area again with split thickness grafts. This was done at the beginning of period 6. The patient stood the procedure well but there was no food eaten the first day and reduced quantities for the rest of the period.

All the grafts took and healing proceeded well. The high diet intake was continued for 20 days beyond period 8. Table IV but accurate measurements were not made. The entire lower extremity was covered by intact skin at this time except for one small bare area which healed during the next 4 weeks. The patient now weighed 24.3 kilograms.

During periods 3 to 8 the patient had occasional nocturnal convulsions. The amounts of nitrogen lost were estimated by reference to the output on adjacent days when complete collection was obtained and the balances given in Table IV were corrected by these amounts. Slight vomiting of food occurred after the large feedings in periods 6 and 7 and this was deducted from the intake—2.1 grams nitrogen in period 6 and 2.3 grams in period 7. The plasma protein level rose from the initial 5.9 grams per 100 cubic centimeters to 7.10 grams by the end of period 4 and remained at this normal level. The plasma albumin level rose from 3.70 to 4.40 grams per 100 cubic centimeters.

After a month of physiotherapy the patient walked out of the hospital. She had slight residual contracture of the knee. There was some foot drop possibly due to burn injury to the superficial peroneal nerve.

EVALUATION

Of what are amino acids capable? When is their use indicated? Are they toxic? Are they practical? Answers to all these questions are not completely given in the comments accompanying the observations presented but the trends of the answers are suggested.

Proper mixtures of amino acids are capable of providing the protein nitrogen requirements of man and animals over long periods of time. They may be given either by mouth, by vein or by subcutaneous injection. Intraperitoneal injection has been successfully used in the dog (20). The importance of continuously adequate nutrition need not be discussed here. Either mixtures of crystalline amino acids or certain protein digests are capable of providing the protein share of it.

The formula for the perfect preparation of protein nitrogen is yet to be written. There are advantages and disadvantages to all substitutes for natural protein. Digests are of less known composition, more difficult of reduplication, more inflexible in composition, currently are less tolerable upon rapid injection than certain synthetic mixtures of amino acids. On the other hand they are inexpensive to produce. Amino acid mixtures contain the unnatural isomers of certain amino acids, but as discussed later no real toxicity has been demonstrated for these unnatural isomers. The question of better utilization of amino acid mixtures or digests favors the former as judged by plasma protein production experiments in dogs (20). There appears to be little difference between amigen and mixture vuj intravenously in the brief test in Table I. By mouth, in the comparison of Table II, amigen is associated with a lower undetermined fraction of urinary nitrogen but this test is clouded by the exacerbation of diarrhea (Case 1, Table II). Use of the mixture vuj in dogs (18) indicates a lower tolerance for it than the tolerance for some other mixtures (21). These latter and others should be tested in man.

Uses for amino acids other than the general nutritive one may be expected to appear. Individual amino acids or mixtures of individuals may be involved. The use of methionine in circumventing or alleviating toxic agents has been described in dogs (22, 23) and tested clinically (5, 14). It is a further stimulating suggestion that most of the effect of added protein intake in preventing negative nitrogen balance after injury (18) may be achieved equally well by added methionine (9), an observation not yet confirmed (27).

Indications for the use of amino acids for nutritional purposes exist only when natural protein cannot be effectively used. The study in Table IV demonstrates the importance of vigorous effort in the use of natural protein. Anyone who might order parenteral feeding in such a case because of its superficial ease or therapeutic impressiveness can recognize from such comparisons in Tables I and II that efficiency of utilization may be sacrificed somewhat. However for the feeding of pa-

tients who cannot or should not be given protein by mouth their value parenterally is great.

There are indications for their use orally. They appear to have marked value in the treatment of peptic ulcer from the interesting work of Co Tui, using amigen. Here their buffering capacity may be as important as their nutritive value. Used to fortify the diets of protein depleted individuals they should theoretically have considerable value. Such individuals must have reduced capacity to secrete the intestinal enzymes, which are proteins. Predigested protein should therefore be better handled. To illustrate this point an observation of Reisenstein and Al bright is pertinent. A young man fed wholly by parenteral amigen and glucose for 26 days was given at the next meal a full diet of natural food by mouth. He accepted it and digested it without the slightest disturbance. A fasting individual protein depleted would usually not be capable of this but must start with cautious feeding gradually increased. The difference appears to lie in the reduced capacity of the depleted individual to produce gastrointestinal juices and enzymes.

A serious toxicity has yet been described with the use of proper amino acid mixtures or digests. Intolerance to the rapid injection of amino acid mixtures containing glutamic acid or much aspartic acid is manifested by vomiting in dogs (21, 16). The usual casein digests contain considerable glutamic acid. It is suggested in the observations of Table I of this paper that phenylalanine may be less tolerable than the other essential amino acids. Toxicity has been inferred for unnatural isomers but is not proved by the demonstration of interesting urinary metabolites related to their administration (1).

The use of amino acids will become increasingly practical. Further improvements are desirable in the palatability of oral preparations. Greater availability of the more tolerable intravenous preparations, such as proper mixtures of the crystalline amino acids or of digests free of glutamic acid and aspartic acid should be provided. Complete parenteral feeding is not now limited by the nitrogen intake so much as by the lack of suitable

means of providing a high caloric intake. Efforts to produce a satisfactory fat emulsion for intravenous administration have been long but are not yet successful (17).

SUMMARY

There are two sources of protein for meeting the needs of the body. One is that portion of body protein which can be mobilized for a particular need in time of emergency—called the reserve protein. The other is the main and ultimate source of protein—the exogenous intake, normally dietary.

Of the two general routes for supplying the exogenous protein needs in disease therapy the oral route is shown to be preferable. The parenteral routes are shown to be valuable, even life-saving when oral intake is impossible or inadvisable.

Mixtures properly prepared of the crystalline amino acids threonine, valine, leucine, isoleucine, lysine, tryptophane, phenylalanine, methionine, histidine, arginine and glycine are adequate for the protein nitrogen needs and marked weight gain of patients over long periods of time. Given parenterally as the sole protein nitrogen intake these amino acids are adequate for nitrogen balance in human patients.

Histidine omission from a mixture of amino acids given intravenously to a patient with ulcerative colitis resulted in a negative nitrogen balance.

One amino acid mixture gave similar nitrogen retention and urinary nitrogen partition to that obtained with the protein hydrolysate amigen during a brief comparison. Neither was quite so well utilized parenterally as orally and neither was quite so well utilized orally as the better natural food proteins.

No toxicity to the unnatural isomers of 7 essential amino acids was demonstrated.

These crystalline amino acid mixtures are well tolerated subcutaneously as well as intravenously even in more than 12 per cent concentration in aqueous solution. It appears, moreover, that further improvements in tolerance can be made. Phenylalanine has been shown to be a limiting factor in tolerance.

Marked clinical improvement occurred in a patient with chronic ulcerative colitis fed

certain amino acid mixtures parenterally together with carbohydrate fat, and accessories orally. No improvement occurred when the amino acids were also given orally.

The value of certain amino acid mixtures in the preoperative and postoperative nutrition of 2 patients was also demonstrated.

Plasma protein levels in the range commonly regarded as low normal may be found in patients showing virtually complete exhaustion of body protein reserves. A high protein intake actually measured and given to such a protein depleted patient with a chronically unhealed wound brought about complete healing after all other treatment had failed.

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REPAIR OF LARGE ABDOMINAL DEFECTS BY PEDICLED FASCIAL FLAPS

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TWO PEDICLED FASCIAL FLAPS FOR CLOSURE OF LARGE DEFECT IN UPPER ABDOMEN

LARGE fascial defects in the upper abdomen as a result of antecedent operations are difficult of satisfactory closure by any method. A number of years ago (1932 and 1934) the present writer described the repair of recurrent and difficult hernias and other large defects of the abdominal wall employing the iliotibial tract of fascia lata pedicled on the tensor fascia femoris muscle as a graft. This method constitutes a very satisfactory means of dealing with large defects of the abdominal wall situated below the umbilicus. Even in patients with long femurs, the longest possible length of iliotibial tract of fascia is usually too short for the repair of defects immediately beneath the costal margin without tension. Furthermore attempts directed at approximating the widely separated fascial edges in an incisional hernia of wide dimensions anywhere in the abdomen are probably ill advised. First because sutures tied under tension invite necrosis of the approximated tissues and the recurrence of the hernia. Second leaving the abdominal wall tight as a drum in the process of repairing a large ventral bulge may in itself invite disaster owing to the baneful effects of increased abdominal pressure.

Necessity compels search for a satisfactory method of dealing with such hernias. In the latter part of 1944 when confronted with a very large hernia in a vertical incision extending from the ensiform cartilage to a few centimeters below the umbilicus I hit upon the method to be described herein. Fortunately however the patient was thin and it was possible to approximate the wound edges of the defect without too great tension. A few months later however a patient presented

himself with a large defect originating beneath the right costal margin and extending well beyond the midline. At operation the fascial defect measured 24 centimeters in length and 18 centimeters in width. No local sliding of tissue could possibly have succeeded in closing the defect. The antecedent story is as follows.

Mr. L. L. aged 63 years, University Hospital No. 78025 was admitted with acute intestinal obstruction associated with large distention of the colon on June 31, 1943. Transverse colostomy was done a few hours after admission. The intraluminal pressure was 3 centimeters of water, 3000 cubic centimeters of gas was aspirated on closure of the skin. On June 30, 1943 primary resection was done for the obstructing carcinoma of the pelvic colon, which proved to be an adenocarcinoma on microscopic examination. The tumor was adherent to the left ureter necessitating division and ligation of the ureter. A diverticulum of the bladder also was excised. Thirty (30) centimeters of colon was removed, the bowel and tumor weighed 440 grams. Colonic continuity was established by oblique end-to-end anastomosis. The patient was dismissed from hospital 20 days later and returned for closure of the colostomy on July 28, 1943.

In August 1944 the patient returned because of the presence of a large tumor in the abdominal wall near the umbilicus. About a year previous to the decompressive colostomy done here for acute obstruction the patient had undergone repair of a large umbilical hernia elsewhere with excision of the umbilicus. On August 18, 1944 I operated upon the patient again for excision of the abdominal wall tumor believed to be an implantation transfer of malignancy to the abdominal wall, during excision of the carcinoma of the pelvic colon.

A good portion of the abdominal wall had to be sacrificed and a loop of small intestine was also excised. The abdominal wall could not be closed satisfactorily owing to the large defect occasioned by excision of the abdominal wall tumor. On microscopic examination, the growth proved to be a desmoid tumor. The desmoid tumor weighed 375 grams and measured 8 by 7.5 by 6.5 centimeters.

A large hernia resulted (Fig. 1). The patient was operated upon for repair of this defect on March 9, 1945. The defect was very large measuring 24 by 18 centimeters. The hernia was repaired by the method illustrated in Figure 2. Intimate adherence of a loop

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of small intestine to the lower margin of the hernial sac necessitated sacrifice of a loop of small intestine approximately 15 centimeters in length. Intestinal continuity was restored by oblique end-to-end anastomosis. Soon after the start of the operation and frequently throughout the procedure the patient's pulse was often very slow; on one occasion it was counted over a period of several minutes at 32 beats per minute. When the pulse was slow the blood pressure also was usually low, frequently as low as 70 centimeters mercury. The cause of this phenomenon remained obscure. A cardiogram made directly after operation failed to indicate any evidence of coronary disease. This queer behavior of the pulse and blood pressure may have been due to the cyclopropane anesthesia which was employed in all the procedures. I am inclined to believe, however, that it was a vagus effect occasioned by manipulation of the intestine—a circumstance which I have observed previously, particularly when the intestine is distended.

The patient did well and left the hospital on March 20, 1945, 11 days after operation. Subsequent examinations indicate that the abdominal wall is strong and firm with no suggestion of a defect or recurrent hernia. Recent photographs indicate that the functional result is excellent (Figs. 3 and 4). There is no evidence of recurrence of the desmoid tumor or of the cancer of the colon.

TECHNIQUE

In the instance herein recorded a large flap of the fascia covering the entire right rectus muscle and the greater portion of the left rectus muscle also was delineated. The dissection was begun just below the most lateral extent of the hernial defect on the left, the incision extending vertically downward to the pubis. On the right side the fascial flap contained a good portion of the external oblique aponeurosis as well. The flap was mobilized from below upward but not quite to the lower edge of the hernial defect. At the right extremity of the hernial defect muscular fibers of the external oblique muscle were present in the mobilized flap. In the lower abdomen the dissection was carried laterally to bare the spermatic cord in the inguinal canal.

This fascial flap, pedicled from its attachment at the inferior margin of the hernial defect, was quite adequate to cover the hernial opening. A large portion of the patient's small intestine had been contained in the hernial sac. In freeing the adherent loops of bowel the peritoneal surface of one segment of jejunum was traumatized enough to suggest

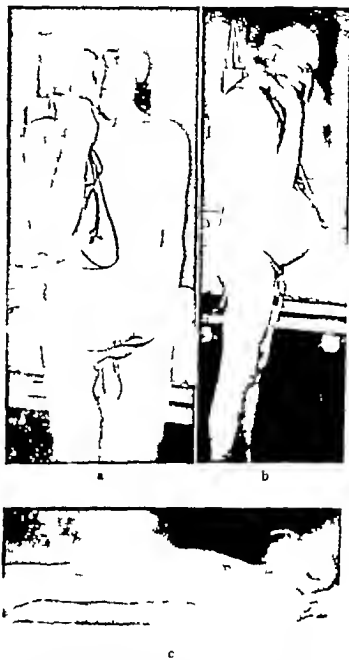


Fig. 1. Photograph of patient, Mr. L. I. Underst, Hospital No. 724005, before operation. a, b and c, Views of hernia in upper abdomen from various directions.

the necessity for resection of the segment followed by an oblique end-to-end anastomosis. The fascial flap was sutured in place with interrupted sutures of fine silk (No. 000).

On completion of this procedure the iliothoracic tract of fascia lata pedicled on the tensor fascia femoris muscle was mobilized from the anterolateral aspect of the right thigh as shown in Figure 2. This technique has been described in detail elsewhere. () A fairly large subcutaneous tunnel was established

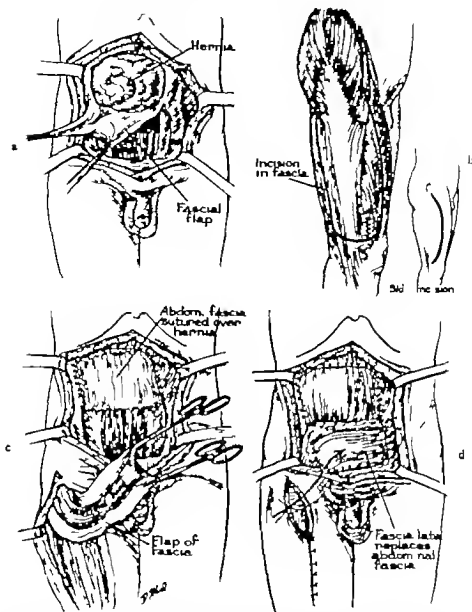


Fig. 2. Schematic drawings indicate the steps in the operative repair of the hernia shown in Figure 1. a. The defect immediately below the right costal margin, measuring 8 by 24 centimeters. A pedicled musculofascial flap is swung up from the lower abdomen to fill in the upper abdominal defect. The flap consisted of the entire anterior rectus sheath beneath the umbilicus, together with portions of the external oblique aponeurosis and fibers of the right external oblique muscle. b. The iliotibial tract and its lateral extension of fascia lata demarcated as a flap. c. The fascial flap from the lower abdomen is swung into the abdominal defect. The pedicled flap from the thigh is ready to be brought over Poupart's ligament into the abdominal wound. d. Both flaps have been sutured in place.

over Poupart's ligament to permit drawing the fascial flap into the abdominal wound.

Prior to operation it had been ascertained that the distance from the greater trochanter to the upper margin of the hernial defect was

36 centimeters. The greatest possible mobilizable length of iliotibial tract of fascia below the greater trochanter was only 31 centimeters. Obviously the pedicled iliotibial tract could not be made to reach to the upper margin of

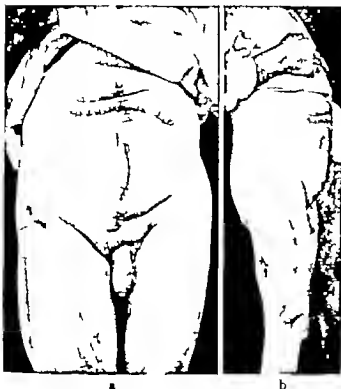


Fig 3

the hernial defect. It did suffice nicely, however, to cover the entire fascial defect in the lower abdomen created by swinging the first pedicled fascial flap.

REPLACEMENT OF INFRAUMBILICAL MUSCULO-TENDINOUS PORTION OF THE ABDOMINAL WALL BY A SINGLE PEDICLED FASCIAL FLAP

The earlier presentation concerned itself primarily with the management of recurrent and difficult inguinal and femoral hernias (1934) by means of a pedicled fascial flap from the thigh. It is desired to record here, with the instance of a boy of 15 from whose lower abdomen a large desmoid tumor weighing 1500 grams was removed. In the removal of the tumor it became necessary to excise the greater portion of the musculotendinous structure of the infraumbilical portion of the abdominal wall. This large defect was closed easily and satisfactorily by swinging up the iliotibial tract of fascia lata which was pedicled on the tensor fascia femoris muscle and was re-enforced by lateral extensions of the fascia lata.

E. B. University Hospital No. 686592 admitted to the University Hospital on October 23, 1939. Preoperative diagnosis: large abdominal tumor.



Fig 4.

Fig 3. Photographs made while the patient was still in hospital. a, The abdominal incision. b, The thigh incision.

Fig 4. Photographs made 5 months after operation. a, The abdominal wall is strong; there is no evidence of a fascial defect or hernia. b, The thigh incision.

The patient, aged 15 years, gives a story of operation for acute suppurative appendicitis about 3 years previously. The three old scars on the abdominal wall shown in the photograph (Fig. 5) indicate the sites of drainage at the time of appendectomy. He said that his abdomen enlarged gradually, but his father was not aware of it until just before admission, when he took his son to a local physician who referred him here for operation. The tumor appeared to be in the abdominal wall. On rectal examination the tumor mass could be distinctly felt. A cystogram was made which showed a definite indentation of the bladder on the anterior abdominal wall, the bladder being pushed distinctly posteriorly. It was obvious that this would necessitate an enormous operative procedure to excise it, yet in the light of previous experience with large defects in the lower abdomen it did seem worth while to undertake excision of the tumor. Closure of the defect, it was believed, could be effected by the use of a fascial flap from one or both legs.

Operation was done on October 25, 1939, under intratracheal cyclopropane anesthesia. A vertical skin excision was made in the midline extending from the umbilicus to the pubis, also a vertical incision on the lateral aspect of the thigh from just beneath the anterior superior spine to above the knee.

At operation there was found an enormous tumor which filled the entire pelvis, pushing the bladder posteriorly. There was an indentation on the tumor from pressure on the bladder. The tumor arose apparently from the rectus fascia in the lower abdomen and from the pubis. The removed tumor weighed 1500 grams.

TECHNIQUE

Through the aforementioned vertical incision the tumor was gradually exposed. It was found to lie on the parietal peritoneum. The only site at which the abdominal cavity was opened was at the umbilicus. A slip of gut came up into the wound where the gut



Fig. 5

Fig. 5. Preoperative photograph of D. B. aged 5. University Hospital No. 686593. a and b, The large protuberance caused by the desmoid tumor of the abdominal wall. c, Indicates the posterior displacement of the bladder caused by the tumor. d, The tumor.

was apparently attached to the umbilicus. The infraumbilical portion of the rectus muscles, including the anterior and posterior sheaths of both recti; the external oblique aponeurosis as well as the internal oblique, except for the musculotendinous portion of the abdominal wall lateral to the vas deferens and spermatic cord on each side was sacrificed. The abdominal wall was undercut above the umbilicus and a bit of the rectus muscles and sheaths extending above the umbilicus had to be excised. The resultant defect constituted a large area extending from the pubis below to about an inch above the um-



Fig. 5c

bilicus superiorly. The only portion of the lower abdominal wall remaining intact lay lateral to the spermatic cord on either side.

At this juncture a large flap of fascia including the iliofemoral tract of fascia in the middle and the extensions of the fascia lata covering the sartorius medially and the biceps femoris laterally pedicled on the tensor fascia femoris muscle, was brought up beneath Poupart's ligament and sutured into the defect. As the

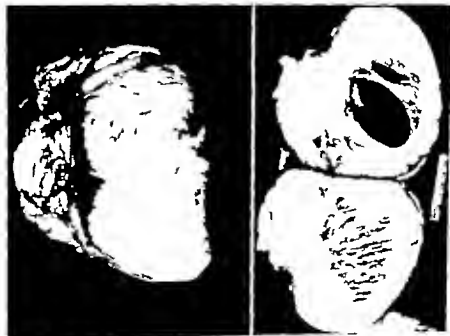


Fig. 5d.

operation was begun. It was thought that fascia from both thighs might be necessary. The generous unilateral fascial flap however, proved quite adequate to close the defect. The musculotendinous defect into which the fascial flap was swung was 15 centimeters long and 13 centimeters wide. Because of the large persisting space overlying the bladder occasioned by the removal of the tumor it was thought well to leave a small drain in the prevesical space. The patient stood this prolonged operative procedure well and left the table in good condition. No attempt was made to close the fascial defect in the thigh; the skin edges merely being coaptated with fine silk sutures. He was dismissed from hospital on November 29, 1939.

The pathological diagnosis (Dr. Robert Hebbel) follows:

The specimen consists of a sharply demarcated somewhat lobulated mass measuring 14 by 15 by 12 centimeters. There are some attached portions of fascia and skeletal muscle. On section the tumor is fibrous and moderately firm. Centrally there is a large cystic area 7.5 centimeters in diameter which is filled with slightly mucoid fluid. The mass weighs 1500 grams.

Microscopic examination shows that for the most part cells are small and separated by an abundance of intercellular material. In a few areas and particularly in a section of a fragment removed separately from just above the penis the cells are more plump and present a greater amount of cytoplasm.

Conclusion: Fibrosarcoma, grade I of desmold tumor of the abdominal wall.

This boy, now 21 years of age, has been observed periodically in the outpatient clinic since the time of his operation in October, 1939. The abdominal wall is strong; there is no evidence of recurrence of the tumor and there is no hernia. He is able to do heavy work but was rejected for military service because of the history of the abdominal wall tumor. Shortly after the initial operation my colleague Dr. Arnold Kremen, now on military leave, examined the literature of desmold tumors. He told me that this tumor weighing 1500 grams was the largest desmold tumor removed surgically on record since 1900.

SUMMARY

A method is described for increasing the range of utility of the iliotibial tract of fascia pedicled on the tensor fascia femoris muscle



Fig. 4. A photograph made in June 1945 more than 5 years after the operation. The abdominal wall is strong and there is no defect in the fascia, nor evidence of hernia. a, The abdomen. b, The incision in the thigh.

in the repair of abdominal hernias. By employing the pedicled iliotibial tract as a replacement for a pedicled fascial flap swung up from the lower to the upper abdomen any hernia of the abdominal wall becomes amenable to treatment by this method. Heretofore incisional hernias with large defects in the upper abdomen have been difficult problems to resolve by any of the available methods. The procedure herein described gives promise of constituting a means of dealing satisfactorily with large defects of the upper abdominal wall. The method possesses the advantage over free fascial grafts of insuring satisfactory wound healing.

The instance of a patient having a defect 24 centimeters long and 18 centimeters in width in the upper abdomen following excision of a large desmold tumor of the abdominal wall is reported. A good firm abdominal wall resulted. A nonirritative nonabsorbable suture such as fine silk is the suture material of choice for anchoring the pedicle graft.

An instance is cited also in which the iliotibial tract of fascia pedicled upon the tensor fascia femoris muscle was employed to replace the larger part of the musculofascial portion of the abdominal wall below the umbilicus attending excision of a large desmold tumor

weighing 1500 grams. The defect was 15 centimeters in length and 13 centimeters in width. A single pedicled graft of the iliotibial tract supplemented by its lateral extensions of fascia lata sufficed to fill the defect.

Removal of such large fascial flaps from the thigh does not impair its function and is not followed by untoward effects.

ADDENDUM—

Since this paper was submitted for publication 3 additional patients have been operated upon for the repair of large abdominal defects. In the first a patient with an unusually large incisional hernia the plan of operation described herein was employed. Each of the other 2 patients presented a large carcinomatous mass in the abdominal wall following a Mikulicz exteriorization operation for cancer of the pelvic colon. The case records follow.

CASE 1 Mrs. A. E. aged 66 years University Hospital No. 601240 was admitted on September 30, 1945 for repair of a large incisional hernia following drainage of the gall bladder (long vertical right rectus incision) performed elsewhere several years previously. An unsuccessful attempt had been made before admission here to repair the hernia. The defect was enormous and extended from the pelvis to the costal margin. In extent the defect measured 26 by 21 centimeters. The scheme described in this paper was employed to close the defect. Fascial flaps from the lower abdomen constituted by the anterior rectus fascia and its lateral extensions were delineated from both sides of the long vertical defect. The upper and most lateral wing of each of these pedicled fascial flaps was swung upward to close the upper portion of the hernial defect. The longest and widest possible pedicled fascial flap was swung up from the right thigh pedicled on the tensor fascia femoris muscle employing the entire iliotibial tract of fascia. A satisfactory closure of the large defect was obtained. The abdominal wound healed kindly and the abdominal wall appears strong with no suggestion of a persistent defect. Owing to the curved nature of the incision on the thigh, a small slough occurred at the convex portion of the skin flap which prolonged the hospital stay. The final result seems to be very satisfactory.

CASE 2 Mrs. J. K. aged 66 years, University Hospital No. 757515 was admitted to the University Hospital on August 30, 1945 for a recurrent carcinoma of the abdominal wall and sigmoid colon following an exteriorization operation performed elsewhere 3 years previously. Excision *en masse* of abdominal wall and colic tumor with primary closed anastomosis. A mucocele of the appendix was excised also. A large fascial flap pedicled on the tensor fascia femoris muscle from the left thigh sufficed to fill the large abdominal wall defect. The patient was dismissed from hospital 8 days after operation. The abdominal wall is strong.

CASE 3 Mr. G. S. aged 64 years, University Hospital No. 760142 was admitted on November 14, 1945 had a large fungating cauliflower lesion in the abdominal wall. Two earlier Mikulicz exteriorization procedures had been done elsewhere for a carcinoma of the lower pelvic colon, the first 2 years prior to admission here. At operation, November 19, 1945 the major part of the infraumbilical portion of the abdominal wall was excised including the skin. There was a single large metastasis in the liver which was said to have been present already at the time of the first exteriorization operation done 2 years previously. The tumor involved the rectosigmoid area and was intimately adherent to the bladder and several coils of small intestine. There was a separate fairly large carcinoma in the midtransverse colon. The left ureter was sacrificed. The tumor of the abdominal wall was excised *en masse* with the colon and a primary closed anastomosis was effected between the proximal third of the transverse colon and the rectum 11 centimeters from the anus. The resultant abdominal defect involved all the structures of the abdominal wall including skin, fascia, muscle and peritoneum. The defect was 20 centimeters from above downward and 16 centimeters across in a horizontal direction. A long fascial flap was swung up from the left thigh which replaced satisfactorily the peritoneofascial defect. The skin was closed by a sliding maneuver. This 10 hour operation was without incident by the patient. Owing to some tension, a slough occurred in one of the skin flaps necessitating a secondary skin graft. The patient otherwise made a satisfactory convalescence and the abdominal wall is strong. At present the patient is at home awaiting re-entry for excision of the hepatic metastasis.

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CHEMOTHERAPY AND CONTROL OF INFECTION AMONG VICTIMS OF THE COCOANUT GROVE DISASTER

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AT the time of the Cocoanut Grove disaster opinions concerning the efficacy of various forms of sulfonamide therapy in wounds and burns were still divided. Lyons (3) had reviewed the literature dealing with the rationale of local sulfonamide therapy and also the somewhat meager clinical reports then available on its prophylactic value. He observed that "the rather enthusiastic clinical adoption of local sulfonamide therapy had failed to provide factual data for analysis of the extent to which such treatment had prevented the growth of bacteria in wounds.

Such data were being accumulated at that time by the Contaminated Wound and Burn Projects sponsored by the Subcommittee on Surgical Infection of the National Research Council. The results of these carefully controlled observations were already providing evidence which served to temper considerably the enthusiastic reports brought back by some of those who had an opportunity to observe the casualties at Pearl Harbor.

Based on the evidence which was available at that time and which was subsequently confirmed and greatly amplified in Meleney's report (5) the Burns Project¹ as set up at the Boston City Hospital at the time of the Cocoanut Grove fire did not include the local use of sulfonamides. There were only 2 cases among the Cocoanut Grove victims at this hospital in which sulfonamide powder was applied locally on some occasions and 2 others in which sulfathiazole ointment was applied to some of the burned areas about the face.

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The work described in this paper was done, in part, under a contract recommended by the Committee on Medical Research between the Office of Scientific Research & Development and Harvard University.

This therapy however played only a minor rôle in the management of these cases.

The systemic use of sulfonamides in the present cases was undertaken from two separate though similar, considerations. First with respect to the surface burns it was thought that chemotherapy might be useful in limiting infection to the burned areas and that cellulitis and septicemia might thereby be prevented. Secondly since respiratory tract involvement constituted such an important part of the injuries in these cases, the use of sulfonamides was considered to be the best available means of preventing or minimizing pulmonary infections which were expected to complicate these injuries. These indications seemed reasonable on the basis of the known clinical experience although there was very little in the way of conclusive evidence from published reports that the drugs would serve those purposes.

The administration of sulfonamides in many of the present cases involved considerable difficulties. Because of the wide differences in the general condition of the patients, in the extent of their surface burns and respiratory injuries and in other incidental complications the treatment had to be individualized and controlled with great care. The major problems arose chiefly from 3 sources namely (1) shock and its effect on the circulation and on renal function (2) impairment of renal function associated with hemoglobinuria and (3) difficulties in maintaining proper water and electrolyte balance particularly in view of the use of large amounts of plasma and the tendency on the part of some of the surgeons to avoid the administration of additional fluids. All 3 of these factors were thus focused on the one point of avoiding the most frequent of the serious complications of sulfonamide therapy namely those involving the urinary tract.

The present report comprises an analysis of the sulfonamide therapy as actually used in the cases admitted to the Boston City Hospital from the Coconut Grove fire. An attempt will be made to evaluate the results of this therapy as far as that can be done from the data available. The bacteriological findings are summarized for some of the cases in which significant infection occurred in the burned areas and in the respiratory tract. The relevant findings with respect to fluid and drug administration in illustrative cases and groups of cases will be summarized.

ANALYSIS OF THE SULFONAMIDE THERAPY USED

As already intimated neither the local nor the systemic use of sulfonamides formed a part of the program of the routine management of burns in this hospital at the time of the disaster. During the first few hours after the fire little attention was therefore paid to the problem of chemotherapy in the present cases and only an occasional patient received it orally or as part of the parenteral fluid therapy given at that time.

Selection of cases for sulfonamide therapy. During the surveys of all the patients which were made by the authors on the morning and evening after the fire and at regular intervals thereafter particular attention was paid to the problem of sulfonamide therapy. Details of the therapy prescribed depended on the state of hydration, the urine output, the ability of the patient to take medication orally and the results of blood studies. In many instances it was considered inadvisable to start therapy during the first day or two because of the low or absent urinary output, because of nitrogen retention, hemoglobinuria or for other reasons. In other patients with minor burns treatment was not given at first but was started later usually because of the respiratory tract complications.

A total of 76 patients received sulfonamide therapy. In Table I there is given an analysis of these cases with respect to the time when the treatment was begun, its duration and the total amount of drug used. The cases are arranged according to the severity of respiratory tract involvement. Sulfonamides were

not used in 24 of the fatal cases and in 31 of the survivors. The former included most of the patients who had the most extensive surface burns and were in shock at the time of arrival or shortly thereafter and also those with the severest respiratory tract damage who had symptoms of respiratory obstruction soon after they arrived. All of these patients died during the first 2 days and 15 of them died within the first 24 hours. Among the survivors who were not given sulfonamide drugs were 19 patients who were discharged or transferred to other hospitals during the first 18 hours, 4 others with minimal involvement who were discharged within 36 hours and 2 who were kept in the hospital for injuries other than burns. The remaining 6 patients had burns involving 5 per cent or less of the surface area which were not severe and were associated with minimal, if any, respiratory complications. Slight and transient fever occurred in 3 of the latter patients and that constituted the only evidence of possible infection among the patients who did not receive sulfonamide drugs.

Time of beginning treatment. Treatment was begun within the first 24 hours in 20 of the cases, during the second day in 40 cases and later in the remaining 16. Half of the cases of each of the first 2 groups had severe respiratory symptoms and the others had either moderate respiratory damage or fairly extensive burns. Only 3 of the 16 patients in whom treatment was begun on the third day or later had severe respiratory tract involvement. Two of them had no surface burns while the third had burns involving almost two-thirds of the body surface and died on the day after the drug was started. Among those with mild or moderate respiratory involvement in whom treatment was delayed 3 had burns of 20 per cent or more of their body surface. Four had burns of 6 to 8 per cent and the rest had only minor burns. In only 1 of these patients (Case 59) did it seem likely that infection of the wound contributed materially to delay in healing or to the prolonged stay of the patient in the hospital. The delay in starting treatment was usually due to the factors already outlined but chiefly to the fact that the patients had a poor urinary output.

Choice of drug Sulfadiazine or its sodium salt was used more or less routinely and this drug was given to all but 5 of the 76 patients. Sulfapyrazine was used in 2 cases and sulfathiazole in 14 but in only 1 of the former and in 4 of the latter were these drugs used alone. In the remaining cases the sulfapyrazine or sulfathiazole was given after sulfadiazine either because the patient had untoward reactions attributable to sulfadiazine or as the supply of that drug was temporarily exhausted.

Route It was considered desirable to use the oral route for administration of the sulfonamides as far as possible, this method offering the least likelihood of producing urinary tract complications. The intravenous route was used for the initial dose in some of the cases with the severest burns. In almost all such cases fluids other than plasma or blood were being given by this route and the patients were fairly well hydrated. All of the intravenous drug was given as sodium sulfadiazine dissolved in physiological saline in concentrations of 0.5 per cent or less of the drug. As far as could be ascertained, no renal complications occurred that could be attributed to the parenteral chemotherapy. An increase in the nonprotein nitrogen occurred in 2 fatal cases but in both of them hemoglobinuria, oliguria and some elevation of the nonprotein nitrogen were already present before the sulfonamide treatment was started.

Dosage The initial dose of sulfadiazine which is customarily given to adults in this hospital is 4 grams orally or 5 grams of the sodium salt when given parenterally. In the present cases since the drugs were being used chiefly for prophylaxis and also because of the greater possibility of kidney injury and of difficulties of maintaining fluid and electrolyte balance, smaller initial doses were given in many of the cases. In 8 of the patients in whom treatment was begun by an intravenous injection the initial dose was 2 to 3 grams and about one-half of those who received oral therapy were given 2 grams for the first dose. The latter was usually repeated after 4 hours. The maintenance dose was that which is customarily used, namely 1 gram every 4 hours but modifications were made from time to time as indicated by clinical and laboratory

findings in the individual cases. In a few instances the parenteral injections were repeated once after 8 to 12 hours but only 1 patient received 3 and 1 other received 4 intravenous injections. All the parenteral injections given after the first one consisted of 2 to 5 grams of the drug.

Alkalis The use of alkalis was limited chiefly to the patients with extensive burns. They were first given during the early survey of the patients because of the finding of some cases with hemoglobinuria among those who were severely burned. All of these patients in whom hemoglobinuria was detected and most of the others who had extensive burns were given alkalis at that time. They were administered in the form of sodium bicarbonate orally when possible or in the form of $\frac{1}{2}$ molar sodium lactate intravenously as a supplement to other parenteral fluids. The alkali therapy was intended as a preventive against possible renal complications. These were anticipated more because of the hemoglobinuria than from the chemotherapy although the latter consideration also entered into the decision to use the alkalis.

It must be stated however that the alkalis were not given without some hesitation. The possibility of water retention resulting from the sodium administration¹ and the consequent aggravation of the edema and exudation from the wounds or the development of pulmonary edema were considered. The finding of highly acid urine in the cases of hemoglobinuria was the deciding factor. An attempt was made wherever possible to adjust the dose so as to give a neutral or slightly alkaline urine. Usually 1 or 2 grams of sodium bicarbonate was given with each dose of sulfonamide. In most instances the alkalis were discontinued after the patient was able to take adequate amounts of fluid and to maintain a good urine output but it was stopped earlier if dependent edema developed outside of the burned areas or if the urine output continued to be small.

Duration of chemotherapy (Table I) Treatment with sulfonamides was maintained for an average of 11 days and a second course of

¹Since the plasma used was derived from citrate, all these patients had already received considerable amounts of sodium from this source.

TABLE I—ANALYSIS OF CHEMOTHERAPY AS USED IN THE CASES ADMITTED TO THE BOSTON CITY HOSPITAL FROM THE COCOA NUT GROVE FIRE

Grade of respiratory involvement	Cases	Mild/moderate	Severe	All cases
Number of patients who received sulfonamides	61	37 ^a	24	75 ^b
Sulfonamide therapy began first day		61	10 ^a	60 ^a
Second day			10 ^a	60 ^a
Third day or later			3 ^a	10 ^a
Duration of sulfonamide therapy Less than 1 day			4 ^a	4 ^a
1-7 days		8	6 ^a	14 ^a
8-14 days		9		9 ^a
15-21 days		3	10 ^a	13 ^a
22 days or longer	11	17 ^a	14	19 ^a
Average number of days	17 ^a	16 ^a	4 ^a	
Number who received drug parenterally		11	3 ^a	14 ^a
Average parenteral dose (grams)	—	4 ^a	6 ^a	5 ^a
Total dose (grams) Less than 60			4 ^a	4 ^a
60-80		5	6 ^a	11 ^a
81-100		10	6 ^a	16 ^a
101-150	5	14		19 ^a
151 or more			6	6 ^a
Average dose	67 ^a	67 ^a	17 ^a	66 ^a

The figures for the total cases are given in the superscripts.

therapy was given before and during skin grafts in a few cases and in some others because of recurrent fever. The cases in which the drug was used for 4 days or less included 9 in which death intervened and 8 in which the burns were either absent or of minor extent and severity and the respiratory damage was relatively mild. On the other hand, those in which treatment was continued for more than 2 weeks included most of the patients who had either extensive and severe burns or severe respiratory damage or both.

Total dose. The amount of drug used in each case was, of course dependent on the time over which it was given. The average total dose per patient was 60 grams which was only slightly less than 6 grams per day. This reflected the fact that, in general, full doses were maintained throughout the course of treatment. In a few instances, however

TABLE II—TOXIC EFFECTS FROM SULFONAMIDE DRUGS OBSERVED AMONG 76 CASES ADMITTED TO THE BOSTON CITY HOSPITAL FROM THE COCONUT GROVE FIRE

Toxic manifestation	No. of cases
Fever without rash	4
Rash and fever	3
Leucopenia (4000 or less)	2
Hematuria (microscopic)	5 ^a
Renal colic	
Nitrogen retention	3 ^b
Nausea and vomiting	1
Total number of patients	17

^aIncludes 1 with drug fever and with renal colic.
^bAll had hemoglobinuria before sulfonamide therapy.
^cIncludes case with rash.

the daily dose was reduced temporarily because of retention of water nitrogen or drug.

Blood levels. Chemical determinations of sulfonamide levels in the blood were done frequently in some cases and irregularly in others. They were carried out frequently in patients in whom difficulties were encountered in the administration of fluids and also in those having abnormal urinary findings or high blood nonprotein nitrogen levels. Some idea of the drug levels found in the blood may be had from Figure 1 which shows the concentrations of free drug observed during the first 3 weeks. For the most part, as will appear later from the data of individual cases, there was a fairly constant and small amount of acetylated drug in the blood about 1 milligram per 100 cubic centimeters in the majority of cases. The level of the free drug in the blood was most often between 4 and 8 milligrams per 100 milliliters. High levels were encountered more frequently during the first few days and low levels were more frequent after the first week. On the whole these low and irregular values reflect the difficulties in controlling the various aspects of chemotherapy in many of the patients, particularly those who were severely ill. This aspect, too will appear from the charts of individual cases.

Toxic effects (Table II). An estimation of the frequency with which toxic effects were observed in the present group is necessarily inadequate. Some of the untoward manifestations were undoubtedly masked or went unobserved for one reason or another. In addition it was difficult to determine whether or not certain manifestations were attributable

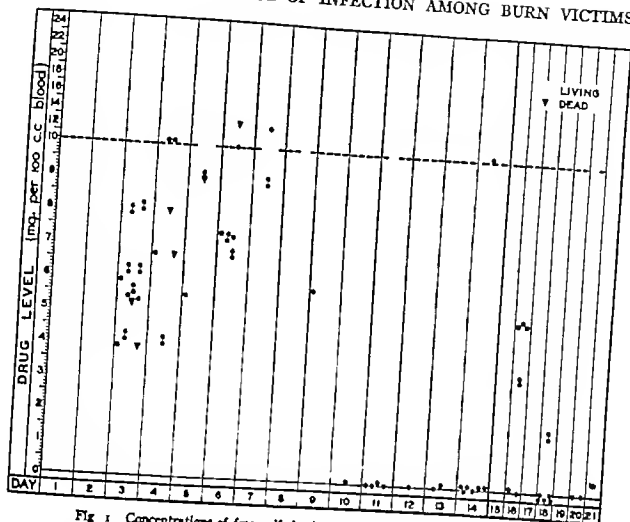


Fig. 1. Concentrations of free sulfadiazine in blood in Coconut Grove cases.

to the toxicity of the drug. Thus there were 3 cases in which blood nonprotein nitrogen levels rose early in the course of therapy but in each case hemoglobinuria oliguria and abnormally high levels of nonprotein nitrogen were noted before the drug was first given.

There were 7 cases in which fever could be attributed definitely to drug toxicity. In 3 instances this fever was associated with a scarlatiniform or morbilliform rash (with epidermitis in one of them) which appeared on the fifth day in one case on the seventh day in another and on the eighth day of the second course of treatment in the third case. In the latter the same drug (sulfadiazine) had been given for 23 days during the first course and an interval of 3 weeks had elapsed before the second course was started. In each of these 3 cases the rash subsided when the sulfadiazine was stopped although sulfathiazole or sulfapyrazine was used to continue the treatment without interruption. Drug fever unaccom-

panied by a rash began on the 10th, 11th, 12th and 20th days respectively, of sulfadiazine therapy. In each of the 4 cases the fever subsided within a day after the sulfadiazine was discontinued and in one of them sulfapyrazine was used to maintain chemotherapy without interruption. In one other patient a second course of sulfadiazine was given after an interval of 10 days and full doses were given for 5 days without a recurrence of the fever.

Urinary tract complications were observed in 5 cases in addition to the 3 with the nitrogen retention which have already been mentioned. Microscopic hematuria was the only manifestation of this complication in 3 cases. It was observed on the 7th and 9th day and was not accompanied by crystalluria. In the fourth case gross hematuria with dysuria occurred on the third day and cleared rapidly when the fluid intake and output were increased. In the fifth case there was renal colic accompanied by microscopic hematuria on the fourth day.

TABLE III — ANALYSIS OF THE OCCURRENCE OF FEVER IN CASES ADMITTED TO THE BOSTON CITY HOSPITAL FROM THE COCONUT GROVE FIRE

Analysis of fever	Sulfonamide therapy				Total
	Given		Not given		
	Recovered	Died	Recovered	Died	
A Onset of fever*					
First day	40		3	10	64
Second day	28		—	—	
Third day	—	—	—	—	
Fourth day	—	—	—	—	
Fifth day	—	—	—	—	3
Sixth day	—	—	—	—	
No fever	—	—	8	—	
Total	68	3	3	—	101
B Duration of fever*					
None		—	3		
day or less	20		—	10	28
1 day	5	4			7
2 days	4	—	—	—	6
3 days	6	3		—	
4-7 days	5	3	—	—	8
8-14 days	13		—	—	14
5 or more days	6		—	—	8
Total	68	3	3		
C Maximum temperature					
First 48 hours					
100-102°	30	6	3	3	
102-103°	26	6	—	—	33
103° or higher			—	3	6
Total cases with fever	57	14	3	6	80
Total cases observed	6	3	3		101
Third and fourth days					
100-102°	7	3		—	24
102-103°	16	3	—	—	9
103° or higher	—	3	—	—	3
Total cases with fever	23				40
Total cases observed	64	3	8		
Fifth to tenth days					
100-102°	3			—	8
102-103°			—	—	3
103° or higher	—	3	—	—	3
Total cases with fever	3	3			20
Total cases observed	6	3	7		20

*100°F or higher

and this cleared within a few hours following intravenous fluid administration

Severe nausea was attributed to sulfadiazine in one case and vomiting was attributed to sulfathiazole in another. These symptoms began early and cleared rapidly when the drug was stopped. Leucopenia was encountered in 2 cases. In Case 47 the white blood cell count was 4,000 on the thirteenth day which was 1 day after the drug had been stopped. In Case 54 the total white count was 2,000 on the twelfth day 2 days before the drug was stopped. The count in this case rose to 16,000 on the fifteenth day without any special treatment directed at the leucopenia. The total dose used was 54 grams in 12 days in the former and 79 grams in 14 days in the latter. In neither of these cases was the percentage of granulocytes depressed.

On the whole, therefore, it may be said that the incidence of untoward effects of chemotherapy was very low. Excluding the cases of hematuria and the 1 case of colic these toxic effects were not serious. It is possible of course that other minor toxic effects were overlooked or that some of the symptoms ascribed to other factors may have been due to the drug. It is fair to say, however, that more serious complications and larger numbers of them were probably avoided by careful vigilance.

RESULTS

Any attempt to evaluate the effects of chemotherapy in the prevention or control of infection in the present group of cases must of necessity be little more than an expression of opinion or of impressions. Even the estimation of the presence, extent and severity of infection was beset with considerable difficulties. As to the burned surfaces, their appearance, odor and the presence of purulent exudate containing bacteria, or the development of lymphangitis or cellulitis in the vicinity of the burns were relied upon to give evidence of infection. The significance of that infection, however, could not readily be determined in each instance. Healing apparently proceeded rapidly in spite of such infection in many of the cases with superficial burns, while in others particularly in third degree burns the

infection undoubtedly contributed to the development of malnutrition and also considerably delayed the healing process. With regard to the pulmonary lesions also it was not possible to determine in most instances to what extent the physical signs and x ray findings were the result either of the original injuries or of superimposed infections.

In order to obtain some idea as to the amount of infection present in these cases some of the objective findings will be summarized. The occurrence of fever and leucocytosis at various intervals after the injuries will be analyzed from that point of view. The available bacteriological findings will be presented and correlated with the other evidences of infection.

Fever An analysis of the occurrence of fever in the patients who were in the hospital for 18 hours or longer is given in Table III. Of the 101 patients in whom data were available only 10 remained completely afebrile. One of these 10 patients died during the first day but the others had only minor surface burns or respiratory injuries. Only 1 of the latter cases received chemotherapy and this was given only during the first day.

Fever occurred very early in most of the cases with moderate or severe burns and in those with respiratory damage. In 85 of the 91 patients who had fever at some time during their course, an elevation of temperature to 100 degrees F or higher was recorded during the first or second day. In almost every instance the fever was associated with surface burns of varying extent. This early appearance of fever can hardly be attributed to infection. It did, however, contribute to the difficulties in recognizing the presence of infection which may have occurred during the first few days. The fever was usually of short duration. In about two-thirds of the cases it lasted for 4 days or less but the proportion of patients having such a short febrile course was smaller among the survivors and somewhat higher among the fatal cases, many of whom died during this period. In most of these cases infection probably played only a minor rôle. In the remaining cases the fever was probably due to infections which usually were limited to the burned surfaces.

The 8 patients who had fever for more than 2 weeks are of interest. In 6 of them the burns involved 20 per cent or more of the body surface. Of the 2 remaining patients one (Case 68) had burns involving only 5 per cent of the body but some of the areas were deep and badly infected. This patient had no respiratory tract involvement. In the other patient (Case 22) on the other hand, the surface burns were relatively clean but there was marked respiratory injury with massive atelectasis of the left lower lobe and probably pneumonia superimposed in that lobe, and these were very slow to clear. In very few other cases could persistence of fever be attributed solely to respiratory tract infections.

In all of the fatal cases there was fever throughout most of the first few days except in those patients who died very early. Among those who recovered and were treated with sulfonamides the proportion of patients having fever dropped progressively from 92 per cent in the first 2 days to 54 per cent during the third and fourth days and 43 per cent during the next 6 days. Among the 13 patients who recovered but did not receive sulfonamides only 5 had any fever. These patients however had only minor surface burns and no respiratory tract involvement and in no instance did their temperature rise above 101 degrees F.

The maximum temperatures observed were usually not very high. In more than half of the cases it was less than 102 degrees F and in all but 12 of the remaining cases it was below 104 degrees. Those in whom the temperature rose to 104 degrees or higher are of special interest. Of the 8 who had such high fever during the first 48 hours only 1 survived. This was a patient (Case 24) with a burn of 14 per cent of the body and a moderately severe (Grade 3) respiratory tract involvement. There was infection of the burned area later in this case but probably little if any infection of the respiratory tract, and the temperature levels were lower after the second day. The remaining 7 patients all died before the end of the second day. The temperature before death reached 106 degrees in 2 of them, 107.5 degrees in the third and 109 degrees in a fourth.

TABLE VI.—BACTERIOLOGICAL FINDINGS IN THE INFECTED SURFACE BURNS IN RELATION TO SULFONAMIDE THERAPY

Case No.	Per cent of surface burned		Chemotherapy			Day of culture	Blood S.D. level	Location of infected burn	Organisms found
	Total	Third degree	Day begun	Day ended	Total, grams				
0	5			6	85		7.6	Back of head	B co; B pyoc; Str a; Diptheroids
	6			11	11	11	8.4	Hand	B co; Str. p; B. coli
						6	—	Hand	B co; Str. p; B. coli; B. morax
1	22	7		8	34			Hand	B co; Str. p; Str. a; B. proteus; B. coli, Diptheroids
				16	5	24	—	Hand	B. coli; B. co; B. pyoc; B. morax; B. fecalis after 48 hrs
						34	—	Hand	Str. p; B. coli; B. co; B. proteus
						42	—	Leg	Str. p; B. proteus; Diptheroids
7	30	5		2	86	30	—	Scalp	B co; Str. p; B. coli; B. proteus; Diptheroids
				14	14	32	—	Scalp	B. M. C., Type B; B. co; Str. p
				20	7	23	—	Graft secretion	B co; B. proteus; B. pyoc.
						46	—	Graft secretion	B co; Str. p; B. proteus; B. pyoc; B. coli
8	5	1		2	2	17	—	Back	B. pyoc; B. co; Diptheroids
						21	—	Back	B co; Str. p; Str. a; B. coli; Diptheroids
15	5			3	6	31	—	Hand	B. pyoc; B. co
24	13	1		2	11	46	—	Trunk	B. pyoc
				14	44	40	—	Trunk	B. proteus; B. pyoc; B. co; Str. p
5	13	13		13	85		9	Hand	B co; B. proteus; Str. p; Diptheroids
30	8			2	4	14	—	Right hand	B. proteus; B. co; B. coli; Str. a; Diptheroids
						12	—	Left hand	B. proteus; B. co; B. coli; Str. p; B. coli
						5	—	Hand	B. co
41	6			14	74	14	—	Grafted area	B co; Str. p; B. M. C., Type B
						41	—	Leg	B co; Str. p
						45	—	Hand	B. co
44	5			2	67	2	—	Right hand	Str. p; B. co; B. coli; Diptheroids
				67	30	7	—	Left hand	B. co; B. pyoc; Diptheroids
49				9	103	14	—	Hand	B. pyoc; Str. a; B. co
60	30			30	107	12	1.9	Back	B. pyoc; B. co; Str. p
						8	—	Back	B co; Str. p; Diptheroids
						22	—	Grafted area	B co; B. M. C., Type B; B. pyoc; Str. p
						62	—	Grafted area	B co; Str. a; Micrococci; B. M. C., Type B
66	30	100		10	42	9	8	Leg	B. pyoc; B. proteus; B. co
				2	14	19	—	Right shoulder	B. pyoc; B. proteus; B. co; Str. p; B. coli
							—	Right flank	B. pyoc; B. proteus; B. co; Str. a; B. coli
							—	Left shoulder	B. pyoc; B. proteus; B. co; Str. p
						27	—	Back	B. co; B. pyoc; B. proteus; B. coli; Diptheroids
11	30	30		20	84	20	—	(Blood culture)	B. morax

*This patient died on the 18th day. Many blood cultures taken during life were negative. B co was cultured from the lungs at autopsy. Explanations and abbreviations.

For definitions of grades of respiratory involvement see Table I.

Days—days after admission (New York day; etc.)

Blood S.D.—blood concentration of free sulfathiazole in mg./100 ml. on day culture was made (or within day) —not done

Sputum: smc = mucoid, pur = purulent; epth = epithelial; squa = squamous; col = coloniform; B S = blood streaked; plug = cells showing phagocytosis of bacteria.

Bacteriology: Str = non hemolytic streptococci; Str a = alpha hemolytic streptococci; Str β = beta hemolytic streptococci; Ps = pneumococcus (type given in Roman numerals); No./M.P.P. = number of encapsulated pneumococci per high power field as seen in Neufeld preparations.

B co = coagulase positive, hemolytic, staphylococcus aureus
H inf = Haemophilus influenzae
B pyoc = Bacillus pyocyaneus
M. col. = Micrococcus catarrhalis
O — gram negative
Percentages shown represent an estimate of the relative numbers on surface cultures (and smears) has not mentioned, the organisms are listed in the order of their relative frequency
B co all were classified as B. coli communis
B. M. C. = Bacillus mucosus capsulatus (Friedlander's bacillus)

hemolysis while in others the alpha hemolytic streptococci occurred independently. The Friedländer's bacilli were all identified as Group B.

Blood cultures were taken during the febrile course in many of the cases and most of them were sterile. *Staphylococcus albus* was recovered from blood cultures in 2 cases, diphtheroids in 1 case and gram negative bacilli in 3 others. The significance of these findings is not certain but the organisms were considered at the time to be contaminants since other blood cultures in the same cases were negative. In Case 131 cultures of the infected wounds were not made but pyocyanous bacillus was obtained from a culture of the blood on the eighth day. Earlier and later blood cultures in this case were negative.

Bacteriology of the sputum. Bacteriological studies of sputum were made on 1 or more occasions in 13 cases including 3 in which cultures were also made of the wounds. In 10 of the cases there were severe grades of respiratory involvement. The sputum specimens were obtained from the patients after the mouth and pharynx were cleared by rinsing and gargling with tap water. They were taken directly to the laboratory where they were streaked on the surface of blood agar plates grown in blood broth and injected into mice. Gram and Wright stained smears were made directly from the sputum and Neufeld typing was carried out when organisms resembling pneumococci were seen. In contrast to the wound cultures those of the sputum were made during the first 2 weeks and while the patients were still receiving sulfonamides. The character of the sputums and the results of the bacteriological studies are listed in Table VII together with a summary of the significant features concerning the chemotherapy employed in the cases.

Most of the sputum specimens obtained early were quite scant mucoid and slightly purulent, and smears showed numerous squamous and sometimes ciliated epithelial cells. Some of the later ones were frankly purulent and had either a yellowish greenish or chalky appearance. In 4 cases, some of the specimens were either rusty blood streaked or pink in color due to admixture of blood.

As was the case in the wound cultures the organism found with the greatest regularity and in the greatest numbers in the sputum was *Staphylococcus aureus*. This organism was cultured from almost every specimen obtained from 12 of the cases and it was the predominant organism found in many of these cultures. All of the strains were hemolytic and produced coagulase.

The streptococci obtained from the sputum were predominantly alpha hemolytic, and some nonhemolytic strains were also found. These were considered to be part of the normal mouth flora although in some instances they constituted one half or more of the colonies that grew in the direct cultures on blood agar plates. Beta hemolytic streptococci were obtained only in Case 36, but although they appeared in considerable numbers there was no clinical evidence of anything which could be interpreted as a hemolytic streptococcal infection in this case.

Pneumococci were obtained in significant numbers in 5 cases. In 3 of them types III, VIII and XXIV pneumococci were obtained only in the first specimen and in 1 case type IV pneumococci were obtained in the first 2 specimens of sputum and no pneumococci could be found in any subsequent specimens. In the fifth case type XXII pneumococci were identified in large numbers in 4 of the 5 specimens studied. In some instances the pneumococci showed evidence of drug action in the stained smears made directly from the sputum. From each of the specimens containing pneumococci other organisms, particularly staphylococci were also obtained in large numbers.

Influenza bacilli were identified in one or more specimens from 4 cases and miscellaneous other organisms were also encountered either in the smears or in the cultures.

The significance of any of these organisms and the part which they played in pulmonary pathology cannot be stated with any degree of certainty. The purulent character of the sputum in some of the cases strongly suggested that the *Staphylococcus aureus* which was so abundant was actually active and contributing to the necrotizing character of the lesions already present in the trachea and bronchi and possibly also in the lungs. I re-

TABLE VII.—BACTERIOLOGICAL FINDINGS IN SPUTUM IN RELATION TO CHEMOTHERAPY

Case No.	Grade of respiratory involvement	Chemotherapy			Day of culture	Blood S.D. level	Description of sputum	Bacteriological findings
		Day begun	Day ended	Total grams				
1	3		16	85	9	0	Muc-pur; B S; carbon; ciliated epith.	Str. or Pa. III (10/H P.F.); few S. ex.
					9	2.5	Muc-pur; B S; carbon; squame epith.	Str. (50%) Str. m. (5%) S. ex. (5%) no I
					14	2.5	Frothy; muc; rusty	Str. m. (50%); S. ex. (10%)
2	3		16	51			Muc-pur; rusty; phag. squame epith.	S. ex. (50%); Pa. IV (10/H P.F.); (5%)
					1	—	Muc-pur; rusty; epith cells—phag	H. lat. (10%); Str. m. (5%); S. ex. (10%); I IV (1/H P.F.); (5%)
					9	—	Muc-pur	H. lat. (15%); S. ex. (40%); Str. m. (5%); no I
7	+		5	34	3	6.5	Frothy; muc-pur; phag. squame epith.	Str. m. (5%); H. lat. (15%); Diploids; few form bacilli in sputum
8	3		17	81	18	4.4	Whisker muc-pur	S. ex. (50%); Str. m. (50%)
			18	27	34	3.5	Chalky; pur.	S. ex. few Str.
					18	—	Throat swab	Str. m. (5%); S. ex. (10%); B. pyoc. G—diplo
13	6		20	80	9	9.6	Yellow muc-pur; squame epith.	Pa. XXII (10/H P.F.); 50%; S. ex. (50%)
					1	3	Yellow; muc-pur	S. ex. (15%); Pa. XXII (10/H P.F.); 15% rare S. ex.
					14	5	Yellow; muc-pur	Pa. XXII (10/H P.F.); clumped; "newly active"; S. ex.; G—rod
					17		Throat swab	S. ex.; Str.
					6		Muc-pur	S. ex. (15%); Pa. XXII (10/H P.F.); clumped; 15%
29	—	—	—	—	—	—	Black; muc-pur; carbon, epith. cells	S. ex.; few Str. ex. Diplotheroids
37	6—		7	90			Muc-pur; B S; sheets of col. phag. squame epith.	Str. m. (5%); Str. B (10%); Str. (10%); Pa. XXII (10/H P.F.); 10%
					1		Muc-pur sheets of phag. squame epith. & poly.	Str. B (50%); Str. m. (15%); S. ex. (5%)
63	—		8	17		0.3	Scant; muc-pur.	Str. squame; H. lat. few S. ex.; few diplotheroids
64	3—			20	3	6.4	Scant; muc-pur	Str. m. M. lat. S. ex. (rare further bacilli & epithelium in sputum)
					4	6.6	Scant; muc-pur	Str. m. M. lat. H. lat. diplotheroids; rare further bacilli and epithelium
69			9	102	3	6.3	Muc-pur phag. poly. & squame epith.	Pa. VIII (15%); S. ex. (5%)
					5	—	Frothy muc. loaded with organisms	S. ex.; M. lat. Str. m.; Diplotheroids (15% each); no Pa.
71			8	16	—	—	Scant; muc. epith cells & poly.	Few S. ex. & Str.
73			6	59	7	8.0	Muc-pur (branches at outpour)	S. ex. seen; few diplotheroids
74	4			26	12		Chalky; peak	Almost pure culture of S. ex.; rare Str.

For explanations and abbreviations see Table VI

Blood culture on 10th day—B. pyoc.

sumably the pneumococci also played a rôle in some of the cases.

As already indicated, it was difficult to determine the part played by infection in the abnormal physical and x ray findings in the lungs. In many of the cases with extensive signs fever and leucocytosis probably resulted from the skin lesions. This was particularly true in those cases in which infection of the

burned areas was apparent. Most of the patients with extensive pulmonary lesions had fever and leucocytosis during part of their course and, with few exceptions, these evidences of infection improved with the healing of the surface burns. On the whole considering the extensive amount of respiratory damage present at the time of admission in this group of cases, it may be stated categorically

that infections of the respiratory tract were relatively few and generally mild. Further more, it seems reasonable to ascribe this comparative mildness and infrequency of the respiratory tract infections to the chemotherapy which these patients obtained during the first week or two in the hospital.

There was also every reason to believe that none of the patients died primarily as a result of infection of the respiratory tract. There is one possible exception. This was a patient (Case 110) with severe and extensive burns who seemed much improved after 3 weeks of a rather stormy course. He was then transferred to another hospital for skin grafting and further care. He had no clinical evidence of pulmonary involvement when he left the hospital and x rays at that time showed his lungs to be essentially clear. Soon after he arrived at the other hospital he developed high fever and respiratory distress and died 6 days later. Autopsy in this case showed an extensive necrotizing type of staphylococcal pneumonia and evidence of the underlying tracheobronchial damage which was similar to that found in other cases. Definite evidence of early confluent staphylococcal pneumonia was also present in Case 107. In this case a tracheotomy was performed early and death occurred on the seventh day and resulted from respiratory obstruction. In the other fatal cases infection played only a minor rôle in the pathology of the respiratory tract as found at autopsy.

CASES ILLUSTRATING THE USE OF CHEMOTHERAPY

It has already been indicated that the urgent needs of patients made it difficult and at times impossible to make and record a considerable number of observations which would have been useful for the purpose of evaluating many important features of the various types of cases encountered. This is particularly true with respect to the evaluation of the results of the various therapeutic agents and procedures used. After the initial phases however a number of studies were made and some of them are of interest in spite of the paucity of earlier data. Because of the peculiar problems presented in the administration

of sulfonamides in many of the cases from the Coconut Grove fire studies of this aspect were undertaken in representative cases as soon as it became feasible. The results of the studies will be presented by summarizing the findings in characteristic cases in which there were various combinations of surface burns and respiratory injuries of different degrees of severity. The data in these cases will be shown in the accompanying figures.

Cases of hemoglobinuria and impaired renal function. Among the first problems encountered during the initial survey of the cases for the purpose of outlining a program of chemotherapy were the scant urinary outputs and their association with hemoglobinuria in a few of those who were most severely burned. As already stated, this finding prompted the use of alkalis which were given at the time with the view of preventing or minimizing renal complications from that source. This procedure seemed justified because of the high acidity of the urine in these cases but the possibility of water retention was borne in mind. Attempts were therefore made to keep track of the fluid balance as far as possible. It was the finding of hemoglobinuria and oliguria which prompted the excessive caution and delay in initiating sulfonamide treatment in some of the cases at least until alkalis had been given and a reasonable output of urine assured.

Details concerning the hematologic and other interesting findings in these cases as well as studies dealing with the mechanism of hemoglobinuria are given in the paper by Shen Ham and Fleming. Most of the Coconut Grove cases in which this complication was recognized died early. The observations relevant to the chemotherapy in 4 of the fatal cases with hemoglobinuria in which death occurred on or after the fourth day are shown in Figure 2 and the findings in the only patient admitted from this fire who survived this complication are shown in Figure 3. Each of these 5 patients had burns which involved 45 per cent or more of their body surface and were mostly third degree. Shock was present on admission in Cases 119, 125 and 131 while in others it was averted in the early phases by vigorous treatment with plasma and fluids.

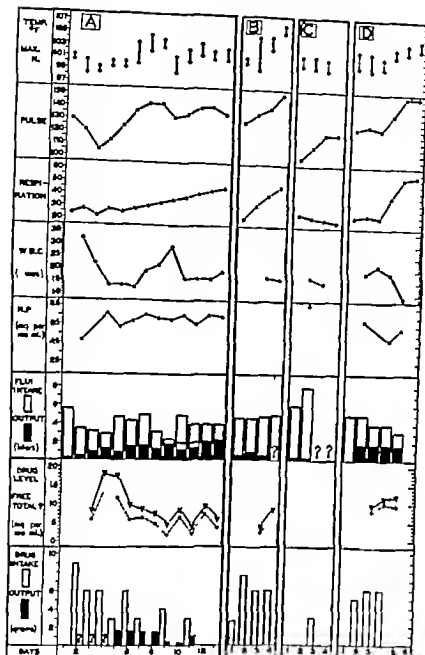


Fig. 2. Findings in 4 fatal cases with hemoglobinuria. A, Case 31; B, Case 119; C, Case 120; D, Case 131.

During the first 24 hours each patient received between 3 and 5 liters of fluid mostly by the intravenous route in addition to the large amounts of plasma. Large amounts of fluid and varying amounts of plasma were also given during the succeeding days. Only 1 of these patients, however, excreted a significant quantity of urine during the first day (Case 38 Fig. 3) and he continued to maintain

a fairly good output. In Case 125 (Fig. 2D) there was a good output of urine on the second day and thereafter. In Case 119 and Case 120 (Figs. 2B and 2C respectively) the output continued to be small while in Case 131 (Fig. 2A) it improved steadily over a period of 4 days.

Sulfadiazine was started at the end of the first day in Case 119 during the second day in Cases 125 and 131 and early in the third day

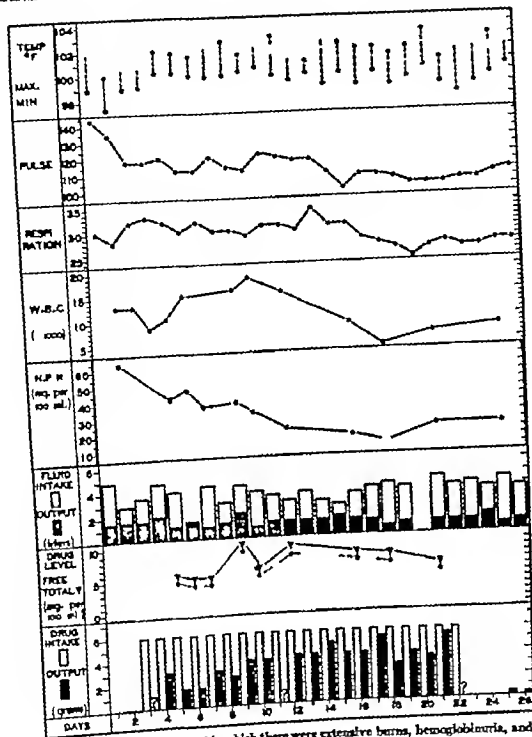


Fig. 3. Findings in Case 38 in which there were extensive burns, hemoglobulinuria, and recovery.

in Cases 38 and 120. The initial dose was given intravenously except in Case 38. Treatment was not continued in Case 120 because of the poor condition of the patient and the failure to establish a good urine flow. The rest of the treatment varied in different cases as shown in the charts.

There was an elevation of the blood nonprotein nitrogen in all but 1 of these cases and

this finding contributed to the caution observed in the administration of the drug. It is interesting to note, however, that this abnormality was not associated with excessive drug retention or with a high degree of acetylation of the drug in the blood, except temporarily in Case 131. In that case and also in Case 125 the blood nonprotein nitrogen remained elevated at a fairly constant level over several

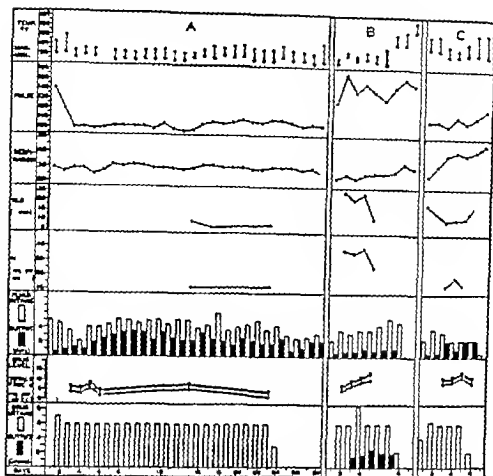


Fig. 4. Findings in 3 fatal cases. A, Case 128 B Case 113 C, Case 107

days while in Case 38 the level dropped progressively to normal. Moderate blood sulfadiazine levels were maintained in each of these cases but it was necessary to reduce the dose to avoid excessive drug retention in Case 131.

Fever, tachycardia, and leucocytosis were present in each of these cases. In 3 of the fatal cases there was a steady increase in the respiratory rate. All of those patients who died had extensive tracheobronchial and pulmonary lesions but evidence of some bronchopulmonary infection was found at autopsy only in Case 131. There was definite infection of the wound in Case 131 and in Case 38.

Other fatal cases. The findings in 3 other fatal cases of different types are shown in Figure 4. All of these patients were in shock during the first few hours in the hospital. In Case 107 (Fig. 4C) there was a burn of moderate severity involving 12 per cent of the body surface but there was marked tracheobron-

chial obstruction necessitating early tracheotomy, frequent aspirations and the continuous administration of oxygen which, from time to time, was given under positive pressure. These procedures gave only partial and temporary relief. In each of the other 2 cases there were extensive and severe burns involving an estimated 30 per cent of the body surface. In Case 128 there were no abnormal physical signs or symptoms referable to the respiratory tract, while in Case 113 there was considerable respiratory distress without any definite symptoms of obstruction.

In each of these cases there was only a small urine output during the first 24 hours in spite of the administration of moderate amounts of fluid. Sulfadiazine was begun at the end of the first day in Case 107 and early in the second day in Cases 113 and 120. The intravenous route was used for the initial dose and for an occasional follow-up dose in the latter 2

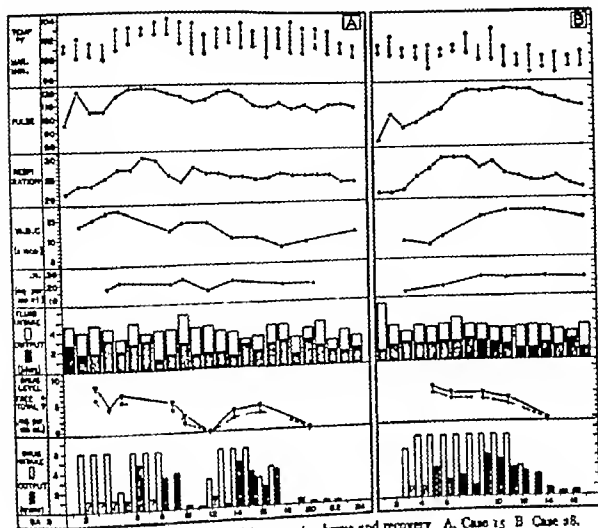


Fig. 5 Findings in 2 cases with fairly extensive burns and recovery A, Case 15 B Case 28.

cases whereas oral doses were used throughout in Case 10.

Slightly elevated nonprotein nitrogen levels were found only in Case 113. Drug concentrations were maintained at a low level in Case 128 and at moderate levels in Case 107 while the initial levels were low and increased gradually in Case 113. There was some difficulty in maintaining good urine output during the first days in each case. There was probably some water retention in Cases 107 and 113 during the last 2 or 3 days. This was evidenced by the finding of dependent edema.

There was only minor infection found in the lungs at autopsy in Case 113 and some confluent bronchopneumonia in Case 107 but both had rather extensive tracheobronchial and pulmonary pathology. In Case 128 death occurred on the eighteenth day and was attributable to malnutrition. The lungs in that case remained clear throughout but there was

considerable infection of the wound off and on after the first 2 weeks.

Cases of fairly extensive burns and recovery
The findings in Cases 15 and 28 are shown in Figure 5. In the former the burn involved 20 per cent of the body surface and in the latter it involved 28 per cent and the patient was in shock at the time of admission. A good fluid balance was readily established in both of these cases. They both had only minor respiratory involvement and this was limited mostly to the upper respiratory tract.

Sulfadiazine treatment was started early in the second day in Case 15 and during the third day in Case 28 and all the therapy was given orally. In the latter patient the therapy was maintained for about a week while in the former it was given with interruptions over a 2 week period. Low grade infection developed in the wounds during the latter part of the treatment and persisted for several weeks in

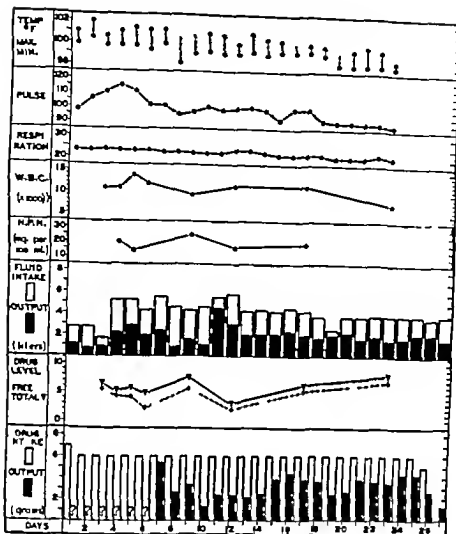


Fig. 6. Case 1

both of these cases. The respiratory tract, however, remained free of infection as far as could be determined.

Cases of severe respiratory tract damage and surface burns of moderate extent. The data in 3 such cases Cases 11, 23, 24, are shown in Figures 6, 7 and 8 respectively. The burns involved 16 per cent of the body surface in Case 11, 6 per cent in Case 22 and 14 per cent in Case 24. While a small part of the burns were deep in the first 2 cases, most of the involved areas in Case 24 proved to be third degree burns. None of these patients were in shock. Each of them received 2.5 to 3 liters of fluid in addition to plasma during the first 24 hours. There was a small output of urine during that period in Case 24 but each of the

others excreted more than a liter during that time.

Full oral doses of sulfadiazine were started shortly after admission in Case 11 and on the second day in the other 2 cases. This treatment was maintained for more than 3 weeks in 2 of the cases while in Case 22 it was interrupted after 2 weeks and then given again for a few days after an interval of a week. The blood levels in these cases remained fairly low most of the time. This may have been due in part, to the fairly large amounts of fluid taken by these patients throughout most of this period. There was no significant increase in the blood nonprotein nitrogen in any of these cases.

Each of these 3 patients had some fever and elevated pulse rate. The fever was low grade

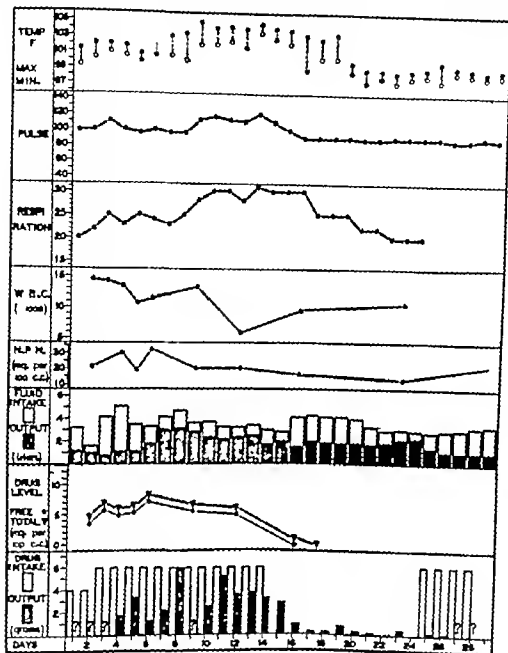


Fig 7 Case 22

and declined steadily during treatment in Case 11 and the patient raised some purulent and rusty sputum containing staphylococci pneumococci and influenza bacilli (Table VII). During this time there were diffuse musical and crepitant rales limited mostly to the lung bases but there were no extensive areas of consolidation. There was also slight infection of the wound which was first noted during the latter part of the second week. In Case 22 the temperature and pulse rose during the latter half of the first week and remained elevated for 2 weeks. During this period there

were definite signs of consolidation and massive atelectasis of the left lower lobe and the patient raised moderate amounts of mucopurulent sputum containing many pneumococci and staphylococci (Table VII). The physical signs and abnormal x ray findings persisted for more than 4 weeks and cleared only gradually thereafter. There was no definite infection of the surface burns.

In Case 24 on the other hand there was moderate infection in the deeper burns. This was accompanied by fever and leucocytosis which began during the end of the first week.

connection with its topical use but it has either been taken for granted or ignored by most observers with respect to systemic administration of the sulfonamides. The latter too requires careful and individualized attention to details if one is to use these drugs intelligently and be able to assess their true value. These difficulties and the failures of chemotherapy with the sulfonamides which are now available justify a continuation of the efforts to obtain less toxic and more readily controllable as well as more effective agents.

In the present cases it is not possible to give any true evaluation of the effect which chemotherapy had in preventing or limiting infection. There are of course no controls for comparison. Indeed there are few similar groups of cases with which such comparisons can be made. At the Massachusetts General Hospital emphasis was placed on strict aseptic technique and eschar producing agents were scrupulously avoided. In this hospital on the other hand aseptic precautions were not rigidly enforced and tanning agents and dyes were applied to the burned surfaces in many of them. Nevertheless, the frequency and severity of the wound infections were apparently quite similar in the Coconut Grove cases at both institutions. Whether or not infection of the wounds would have been more severe had sulfonamides not been used at all can only remain a matter of conjecture. The almost complete absence of septicemia, lymphangitis and extensive cellulitis beyond the confines of the burned areas in spite of the extensive and severe lesions may probably be attributed in part at least, to the systemic use of these drugs. Local infections limited to the burned surfaces on the other hand were certainly not prevented. In this respect the results are similar to those obtained under the more carefully controlled condition in the study summarized in Meloney's report (5).

With respect to the respiratory injuries, on the other hand the comparatively small number of severe pulmonary infections can probably be attributed directly to the use of the sulfonamides. The fact that so few of the patients with severe respiratory damage died after the first few days coupled with the additional fact that those in whom death

occurred after the first 2 or 3 days, had extensive surface burns, can be taken as an indication that pulmonary infections were kept in check. It may be expected that the sulfonamides might have a similar beneficial effect in preventing or controlling the late infectious complications of other pulmonary irritants such as those used in chemical warfare or those sometimes encountered in industry. In 2 other disasters in which respiratory tract complications occurred from fire or irritants or both, pulmonary infection was a major factor in all of the deaths which occurred after the first 2 to 3 days (2, 7).

The organism which was most frequently encountered in the infections of both the wounds and the respiratory tract was *Staphylococcus aureus*. Most strains of this organism are only slightly susceptible to sulfonamides. Prolonged treatment with the maintenance of high blood levels are therefore probably essential if infection with these organisms are to be controlled. Once the necrotizing action of these organisms has occurred and purulent foci become established, such treatment, if successful probably serves only to limit the spread of infection until the exudate is evacuated or local healing takes place. The low sulfonamide blood levels generally obtained both in the cases at this hospital and in those at the Massachusetts General Hospital as well as the failure to pursue the treatment adequately may have been important factors in limiting or minimizing the effectiveness of the sulfonamide drugs. The reasons for the failure of sulfonamides to control the growth of bacteria in surface wounds have been adequately discussed by Lyons (3) and Meloney (5) among others.

It is possible that penicillin would have been more effective in many respects. Even with this agent, however it is now recognized that small doses such as those used at the Massachusetts General Hospital are totally inadequate even for prophylaxis of infection when the *Staphylococcus aureus* or the other usual wound contaminants are concerned. Larger and more frequent doses may be more effective but this still remains controversial (1, 6). It is of interest that even hemolytic streptococci were grown from some of the

wounds in spite of the use of sulfadiazine at both institutions and the added use of penicillin at the Massachusetts General Hospital. Larger doses of penicillin might have been expected to prevent the growth of this organism in the wounds.

The chief advantage of penicillin which remains undisputed at this time is its almost complete freedom from toxic side effects when given systemically and probably also when it is used locally in moderate concentrations. This agent is also more effective against the staphylococcus and against many other gram positive organisms. These attributes are reflected in the improved general condition of the patients with severe and deep wounds after they are adequately treated with penicillin (4). The limitations of the value of penicillin lie in its failure to control the growth of many local wound contaminants and these contaminants may serve to reduce its effectiveness. It is to be hoped that other antibiotics will be found which are just as innocuous to the host but are more effective against a larger range of organisms.

One point of interest which was brought out in the analysis of the present cases may be mentioned briefly, namely the prognostic significance of high fever and high leucocyte counts in patients with extensive burns. Almost all of the patients whose temperatures were over 104 degrees during the first few days died. Likewise the mortality was high among those in whom leucocyte counts above 15,000 were obtained during the first week after the burns were sustained.

SUMMARY AND CONCLUSIONS

The available data concerning the use of sulfonamide drugs in the patients admitted to the Boston City Hospital from the Cocoanut Grove fire were presented. Chemotherapy, chiefly with sulfadiazine, was given only systemically for the purpose of preventing or controlling infection of the surface burns and of the respiratory tract. The management of the chemotherapy in many of the cases was complicated by the presence of shock and by the inadequate urinary output resulting from this or other causes. Treatment was con-

tinued in what are usually considered to be adequate doses for an average of 11 days. Blood levels were often irregular and were usually lower than those which might be considered desirable. Toxic effects were comparatively infrequent and mild.

It is not possible to evaluate properly the effects of the chemotherapy in the present cases. Infections of deeply burned areas occurred after the first week and were fairly frequent but not severe. Extension beyond the burned area was observed in only 1 case. *Staphylococcus aureus* was obtained quite regularly from the infected area and was usually the predominant organism. Hemolytic streptococci and various gram negative bacilli were also cultured from most of the wounds. The virulence of these organisms and their significance with respect to the wound healing varied considerably but was not possible to assess.

Pulmonary infections were few and usually mild. There was some evidence of infection in the lungs of the fatal cases, but extensive pneumonia was found in only 2 of them. Other patients had protracted respiratory symptoms and physical x-ray signs in the lungs with fever and leucocytosis. It was difficult however to determine to what extent pulmonary infection was responsible for these manifestations, since similar signs and symptoms were noted early in most of the same patients and resulted from the injuries which were sustained. Furthermore, most of these patients also had extensive surface burns and infections of these areas contributed to the fever and the leucocytosis. On the whole it was considered that the chemotherapy was responsible at least in part, for minimizing pulmonary infection and for preventing delayed deaths from pneumonia in many cases.

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TABLE III.—SHOCK IN RELATION TO MORTALITY—125 CASES

Degree of shock	Number	Lived	Died	Per cent mortality
None*	57	51	6	10.5
Moderate	35	24	11	31.4
Severe	33	13	20	60.6

*None, no apparent shock, blood pressure above 120, pulse below 100, *Scleritis*, blood pressure below 10, pulse above 100, objective signs of shock present.
Severe, blood pressure below 70, pulse above 100, objective signs of shock present.

ound shock mortality is more than 60 per cent.

It is not within the scope of this paper to discuss the complex and still ill understood phenomena of shock. But there are certain features that have impressed us and are worthy of mention.

1. A clinical picture impossible to differentiate from shock is produced by severe contamination of the peritoneum with the content of colon or distal ileum. There are few cases in which blood loss has not also been a factor. Frequently however the degree of shock exhibited is out of all proportion to blood loss and in most of these cases contamination with colon organisms has been a prominent feature. Burbank has taken hematocrit readings on some of these cases and has found a significant hemoconcentration when blood loss was not marked, near normal hematocrit readings when hemorrhage was combined with contamination in the production of the shock picture, hemodilution when hemorrhage has been the major or sole etiologic factor. We have not, as yet, had sufficient opportunity to confirm these findings but they may be of considerable importance in determining the relative amounts of blood and plasma that are optimum in the treatment of a given patient. A constant observation has been that in those patients in whom contamination is the major or the sole cause for shock, response to replacement therapy is usually slow or non-existent. In these patients the prognosis is very grave.

2. When there is relatively little spillage of colon content, when the perforations are entirely confined to the upper intestinal tract, or the lesions are chiefly or entirely of solid organs, shock is relatively proportionate to blood loss. Unsplinted fractures of major

long bones or disturbances in cardiopulmonary physiology due to associated chest wounds or to blast may disturb this proportionate relationship. It must also be kept in mind that it is possible physiologically to compensate for loss of upwards of a liter of blood from the circulation especially if this loss occurs slowly. The additional loss of relatively small quantities of blood may rapidly induce a state of profound shock. It is well to keep this in mind when considering the replacement of blood loss for the patient faces in every case additional blood loss inevitably associated with major surgery which may prove rapidly fatal if difficulty is encountered in controlling bleeding from a major vessel.

3. Fatal peritonitis has been rare except in those cases in which contamination has not been a major factor in the production of shock. From 1 to 3 hours spent in treating shock is well spent as long as there is continued improvement. The working rule on which we have tried to proceed is as follows: Rapid infusion of whole blood and plasma is begun as soon as possible. An attempt is made to estimate tentatively the probable amounts of blood lost. After an adequate replacement of blood and plasma loss in an hour to an hour and a half's time if there is little or no response to shock therapy there must be active causative factors responsible. In the main there are four such mechanisms most of them amenable to surgery: (a) continued hemorrhage usually concealed; (b) severe fecal contamination of the peritoneum; (c) disturbance of the cardiorespiratory mechanism from thoracic injury; (d) early fulminating anaerobic infection with gas-forming organisms. Blast injury to viscera and massive evisceration less frequently prevent response. If there is no response to shock therapy or if response has begun but is interrupted and the patient's condition begins to deteriorate, operation is begun without delay.

The opinion that massive transfusion of whole blood is essential to the adequate resuscitation of shocked patients cannot be escaped. Plasma has frequently been given in installations first receiving the patient, but is used by us as the initial fluid for replacement

Except in certain desperate cases the wound was closed in layers continuous fine catgut was used in the peritoneum interrupted cotton sutures in the posterior and anterior rectus sheaths. The skin was not closed in any case with perforation of a hollow viscus, as it is our opinion that in most instances wound sepsis originates in the subcutaneous areolar tissue. Coarse mesh vaseline gauze was laid beneath the wire sutures to keep the skin margins apart during the first few postoperative days. A request has been made that these wire sutures be left in place 21 days. No attempt has been made to wall off the operative incision from the exteriorized colon. If there were no hollow viscus perforation the skin margins were approximated with interrupted cotton sutures widely placed. The results have been most satisfactory. There have been no wound dehiscences in the subsequent 100 patients. Cosmetic results have not been optimum but it has not been necessary secondarily to close the superficial wound.

In exploring the peritoneal cavity an attempt is made to retrace the course of the missile. Radical shifts in position of viscera particularly small bowel that may occur subsequent to passage of the missile through the peritoneal cavity should be kept constantly in mind. The blood in the peritoneum is removed by suction and the large clots frequently present both manually and by scooping them out with laparotomy packs. No attempt is made to remove the blood completely because we believe that such a maneuver is manifestly futile and that the blood left acts as an autotransfusion no mat-

tion concealed between the leaves of the mesentery which are likely to be overlooked and are troublesome to close. Particular attention must be paid to the retroperitoneal surfaces of the viscera fused to the posterior parietes. The ascending and descending colons are mobilized and their posterior surfaces inspected if perforation from behind is at all likely. In the same way the duodenum is mobilized by lateral incision and retracted medially to expose its posterior surface. The posterior surface of the stomach is exposed through the avascular gastrocolic omentum or through the transverse mesocolon. The most likely areas for overlooking perforations are thereby exposed. The 2 following cases are illustrative.

CASE 2: An American soldier aged 27 years was admitted 6 hours after sustaining a wound by a mortar fragment that entered the left 10th interspace in the anterior axillary line, the fragments were palpable posteriorly above the crest of the left ilium. The missile had passed through the diaphragm below the pleural reflection, perforated the splenic flexure and entered the retroperitoneal tissues above the left kidney. An anterior perforation was closed after great difficulty was encountered in exposing and mobilizing the splenic flexure. Proximal defunctioning transverse colostomy was performed. The patient died on the 9th postoperative day following a stormy septic course. At autopsy there was found a small perforation on the posterior aspect of the descending colon which had not been closed and drainage from which was responsible for a tremendous phlegmon of the perirenal tissues and the tissues of flank and lower chest.

The extension of this incision through the left rectus and obliques in order better to expose the splenic flexure would have allowed of its complete mobilization and exterioriza-

perforation of the portion of the descending colon between the mesenteric leaves

Whether a small perforation of the colon was missed or whether there was subsequent sloughing of the colonic wall in the area of contusion is not definite. In any case there was an error in judgment. The descending colon should have been exteriorized.

Except for conduction of secretions of liver, kidney and pancreas to the outside no attempt has been made to drain the peritoneal cavity.

That the incidence of involvement of the various viscera is roughly proportionate to their displacement is borne out in Table V. Complex injuries to numerous viscera is the rule, and the contribution to mortality made by each defies statistical analysis.

TABLE V—INCIDENCE OF INVOLVEMENT OF THE VARIOUS ORGANS—130 PATIENTS

Stomach	20	Pancreas	2
Duodenum	6	Adrenal	2
Small intestine	55	Bladder	5
Colon	57	Ureter	1
Rectum	9	Urethra	1
Liver	34	Diaphragm	33
Gall bladder	3	Appendix	1
Spleen	14	Vena cava	3
Kidney	34		

Hollow viscera. Perforation of a hollow viscus was found in 99 cases with a mortality of 38 per cent (Table VI). The tearing action of high explosive fragments tends to produce large lacerations from which spillage of intestinal content is great. The contractile action of the bowel tending to close small perforations minimizes the amount of spillage which in lesions less than 1 centimeter in diameter is usually very slight.

Except for the technical difficulties of approach to the gastric fundus, especially on its posterior surface perforations of the stomach have proved to be relatively benign. Since high gastric lesions are frequently associated with thoracic involvement we have preferred whenever possible to approach them through the chest.

The survival rate of patients with lesions of the duodenum is very low not so much apparently because of factors intrinsic in the duodenum but because of its location near great vessels, the pancreas, the biliary tree,

stomach and colon which tends to make for very complex situation. Duodenal closure even of large lacerations on the posterior no peritonized surface has given little difficulty. None of these closures has subsequently leaked to produce duodenal fistula.

There has always existed among military surgeons firm prejudice against resection of small intestine, founded on previous experience that few survived. Although in complete agreement that simple closure is always to be preferred to resection we have encountered no difficulties with resection per se. We have preferred end-to-end anastomosis chiefly because it has been more rapidly and simply accomplished. With the peritoneum already contaminated closed aseptic anastomosis has seemed an unnecessary refinement, especially since no clamps have been available that met ideal standards of length and narrowness of blades. An open two layer anastomosis has been made in each case, by use of nonabsorbable sutures in the seromuscular layers, and removal of a greater portion of the bowel at the anti-mesenteric border in order to achieve a lumen of greater size. Great care has always been taken that the blood supply of the suture line be adequate. In spite of the fact that all these anastomoses were made in the presence of already established peritonitis none has leaked. Nor has intestinal obstruction developed at the anastomotic site. Patients in whom intestinal resection is necessary will inevitably succumb in higher percentage than those handled by simple closure but it is our impression that this is in very great part due to the greater complexity of the pathology. When several large linear lacerations and transections have occurred in a short segment of bowel it has seemed safer to resect the involved segment and to make a single anastomosis than to attempt plastic closure of these several tears. Linear tears are closed in transverse direction, but great care must be taken that distortion does not make for likely intestinal obstruction later on. Intestinal obstruction varying in degree has been a frequent late complication from plastic peritonitis with volvulus. In most cases the sites of obstruction bearing less relationship to

the areas where perforations were closed or anastomoses made than to the areas where aerosal abrasions have occurred and where the bowel has been handled a great deal during the manipulations of repair.

Colon. Contamination of the peritoneum by colon content is the single most lethal factor producing death in abdominal wounds (Table VI).

TABLE VI.—RELATIONSHIP OF CONTAMINATION OF PERITONEUM TO MORTALITY

	Cases	Dead	Per cent Mortality
Extraperitoneal perforation of hollow viscera	31	0	0
All intraperitoneal perforations	99	38	38
Stomach and small bowel perforations only	41	8	19
Colon perforation	57	30	44

The principle of exteriorization of lacerations of colon is particularly adaptable to the lesions of the colon produced by high explosive and high velocity missiles. Even the smallest perforation of the colon is usually surrounded by an area of ecchymosis which, when observed in the exteriorized loop, invariably undergoes necrosis and sloughs to the very margin of the ecchymotic area. The difficulties of estimation of the extent of this necrosis make simple closure of these lacerations hazardous. In addition exteriorization accomplishes decompression. There are certain situations, however, in which the exteriorization principles are inapplicable or unsatisfactory. These are particularly peculiar to the right colon, large lacerations of which are likely to be accompanied by high mortality because of the liquid character of the colonic content which flows readily into the peritoneal cavity carrying with it a great concentration of organisms which are rapidly disseminated throughout the peritoneum. Exteriorization, with the suturing of ileum to

perforations particularly of the cecum and proximal ascending colon have done very well following the conversion of these wounds into a cecostomy by suturing the colonic wall about a one inch rubber tube and securing it to the deep fascia by several interrupted sutures. When small through and through wounds have been encountered the posterior wound has frequently been closed and the anterior wound converted into a cecostomy in this fashion. The cecostomy is usually removed between the 4th and 6th postoperative days and drainage has ceased a very few days later. By complete mobilization of the right colon and the hepatic flexure exteriorization with the suturing of an adequate spur can usually be accomplished in the distal half of the ascending colon. In those long linear tears, especially in the proximal half of the ascending colon, the most satisfactory answer seems to be resection of the proximal portion to beyond the tear, ileotransverse colostomy (which we prefer to do in end-to-side fashion bringing the proximal hepatic flexure of transverse colon out through a stab wound).

Perforations and lacerations of the remaining colon are exteriorized through a short muscle splitting incision as far away from the primary incision and the wounds produced by the missile as is consistent with the avoidance of tension on the bowel. To this end also attached portions of the colon are liberally mobilized. A spur ideally from 5 to 6 inches in length, is constructed by the simple expedient of turning the bowel toward the center axis of the body suturing the two teniae liberae together with a single running stitch of catgut. Portions of the transverse colon used in making this spur are denuded of their omental attachments. The colostomy thus constructed is opened immediately following operation.

remove them at the initial operation unless they are readily available protruding from the liver surface.

Spleen The gunshot wounds of the spleen have exhibited one striking feature different from the usual experience with closed traumatic rupture of the spleen unless there is a wound of the great vessels near the hilum of the spleen they do not continue to bleed. No satisfactory explanation for this alteration in the usual pattern presents itself. Extensive laceration, even fragmentation of the spleen with free portions herniated into the thorax or free in the peritoneal cavity have been a frequent finding. There is usually considerable free blood in the peritoneal cavity but the spleen itself as encountered at operation is either not bleeding at all or gently oozing. Shock is no more frequent in splenic injuries than in injuries of other abdominal viscera. The following case is typical.

CASE 4. An American soldier aged 24 years was admitted 544 hours after sustaining a wound over the left 11th rib in the anterior axillary line by a mortar fragment. Two units of plasma were given prior to admission. He was not in shock, blood pressure 120/80 pulse 100. The abdomen was boardlike. Stomach contents and urine were negative. At operation the abdomen contained an estimated 2000 cubic centimeters of liquid and clotted blood. There was a tremendous laceration of the lower half of the spleen, with a great deal of surrounding ecchymosis of the ligaments of the spleen but no active bleeding. The diaphragmatic origin was torn below the pleural reflection. Splenectomy was performed and the diaphragm repaired. Except for transient atelectasis of the left lower pulmonary lobe he made an uninterrupted convalescence and was returned to full duty on the 15th postoperative day.

In considering civilian experience in the frequency of secondary hemorrhage following rupture of the spleen we have performed splenectomy for all but the most extremely minor lacerations. The only such case in which it was felt that the slightly fractured spleen could be safely left in had no further difficulty with the spleen during the short period we were able to follow his progress. Splenectomy in cases in which the spleen was the sole abdominal viscus damaged has not resulted in death or severe complication in a single case (Table VII). The transthoracic approach has delighted us in the case with

TABLE VII—MORTALITY FROM SPLENECTOMY
—14 CASES

	Cases	Deaths	Mortality per cent
Transpleuric	9	0	0
From below	5	4	80
Total	14	4	28

*These deaths are due to extensive contamination of peritoneum and pleura by hollow viscus content.

which splenectomy may be performed. If there were no penetration of the pleura, or if the peritoneal pathology were not approachable through the diaphragm the transverse subcostal approach has been used whenever practicable. This series includes 3 patients who have returned to combat duty within 6 weeks after splenectomy.

Kidney ureter and bladder Wounds of the kidney have been seen in 24 patients. In cases with extensive extravasation of blood about the kidney sufficient dissection was carried out to visualize the kidney. As with liver and spleen the renal parenchymal substance has not continued to bleed except for moderate oozing unless the wound were near the hilum involving the major blood supply. Even though there were extensive fractures through the renal substance with portions of the kidney torn completely away and a major calyx involved the treatment has been conservative. Adequate drainage has been established to conduct the urine to the outside. Drainage of urine in these patients has continued for a very long time. Microscopic blood and sterile pyuria have required weeks to disappear. Plastic reconstruction of the kidney by débridement and suture has not seemed indicated. The following case is illustrative of the tremendous powers of healing of the conservatively treated kidney.

CASE 5. A Japanese American soldier aged 27 years sustained a perforating wound from an artillery fragment that passed through the right flank. He was admitted 9 1/2 hours later in severe shock which responded promptly to the administration of 1000 cubic centimeters of plasma and 500 cubic centimeters of whole blood. The missile had torn the lateral 3 centimeters of the right lobe of the liver away almost completely transected the mid-ascending colon and carried away the lower third of the right kidney into the lower major calyx. Neither liver nor kidney was bleeding. The torn colon was exteriorized and the hepatic and renal areas drained through the large débrided posterior wound. Except

for a low grade fever early convalescence was smooth. Urine and bile drained in large amounts through the posterior wound. Six weeks later he was seen at the general hospital in the base still draining bile stained material in small amounts from the small posterior sinus otherwise in excellent general condition. Retrograde pyelograms at this time were normal except for very slight distortion of the inferior major calyx. He stated in a letter almost a year later that he was on limited duty status in a rearward area feeling fine.

Nephrectomy has been performed in 6 instances (25 per cent) in each case because of severe intractable bleeding.

Only 1 lesion of the ureter has been encountered in our personal experience in this case associated with severe damage to the kidney to which the only answer was nephrectomy. We know of no case in which there has been sufficiently slight damage to the ureter to permit of successful plastic repair.

Perforations and lacerations of the bladder have been closed. In certain instances especially when the missile has passed through the floor of the bladder or its anterior wall the dissection in the prevesical spaces has been extensive and the repair difficult. A suprapubic cystostomy tube has been sutured in place for urinary drainage. In many instances indwelling urethral catheter drainage might have sufficed, but the difficulties of maintaining the catheter in place during transportation have made cystostomy the more desirable procedure.

Great vessels. The initial attitude toward the problem of retroperitoneal hematoma was conservative in accordance with the accepted attitude toward the retroperitoneal hematomas of crushing injury of civilian experience. Unless there was continued bleeding the hematoma was left severely alone. An early unfortunate experience (Case 6) which has been repeated in the experience of others has made us more vigorous in exploring these hematomas and in ligating large bleeding vessels, more to avoid the late complication of suppurative thrombophlebitis with fatal septic infarction of lung than to avoid secondary hemorrhage. This has seemed particularly indicated in instances in which the retroperitoneal hematoma communicates through the missile track with the contaminated peri-

toneum and especially when the missile passed through the colon in its course toward the posterior parietes. This attitude has seemed profitable.

CASE 6. An American soldier aged 21 years was admitted 6 hours after fragments from an aerobomb had caused superficial wounds of the right arm and a penetrating wound of the mid-epigastrium. The small missile had passed through the midtransverse colon produced numerous rents and perforations in a segment of ileum a foot from the ileocecal juncture and passed into the retroperitoneal tissues to the left of the midline about 3 centimeters above the origin of the inferior vena cava. The large retroperitoneal hematoma was not increasing in size. There was severe contamination of the peritoneum and the intraperitoneal blood. Resection of a segment of the small bowel with end-to-end anastomosis, the transverse colon exteriorized, the retroperitoneal hematoma not disturbed. For the first 9 days convalescence was satisfactory except for a low grade fever which was first thought to be due to malaria when parasites were found on examination of the blood. At the evacuation hospital he developed an abscess about the posteriorly placed missile lateral to the vertebral bodies which had not been removed. Following the drainage of this abscess he developed severe ileus, high fever, jaundice with marked enlargement of the liver. Death on the 47th postoperative day from a suppurative thrombophlebitis of both femoral veins and inferior vena cava with multiple septic infarcts to lungs and liver.

Exploration of the retroperitoneal tissues might have required ligation of the inferior vena cava, but the removal of the missile and avoidance of the subsequent abscess would probably have saved the patient.

We know of no patient with an aortic wound who has survived to reach the operating table although 2 patients with aortic wounds have succumbed shortly after their admission to our hospital. Lesions of almost every other great vessel have been encountered. Associated with wounds of large vessels is a particular syndrome which it may be well to describe. If the patient has been in severe shock on admission he may make an excellent response to replacement therapy up to a certain point, attaining a blood pressure of perhaps 90 systolic. Or the shock picture may have been slight and response to shock therapy prompt. Immediately however upon the opening of the peritoneum the blood pressure drops to zero with the release of the hydro-



Fig. Case 7. Left thoracoabdominal wound. a, Preoperative vertical roentgenogram of the chest showing stomach herniated through the large rent in the diaphragm, fractured spleen above and medial to the stomach, slight

hemothorax. b, Vertical roentgenogram of the chest 30 hours after thoracotomy showing complete re-expansion of the lung, the stomach reduced, the diaphragm repaired.

static pressure of the collected blood within the peritoneum sustained by the pressure of the abdominal musculature. After ligation of the vessel there is usually prompt recovery from the hypotension. Distention of the abdomen with blood with slow or no response to replacement therapy is a most ominous sign and usually results from a rent in an artery of large caliber. Collected experience has indicated that the great veins may be ligated with impunity including the inferior vena cava up to the level of the renal veins.

THORACOABDOMINAL LESIONS

For purposes of this discussion thoracoabdominal lesions are limited to those in which the missile has passed through both pleura and diaphragm. Combined thoracic and abdominal cases in which there is associ-

ated injury to the chest by one or more other fragments are excluded as are those perforations of the diaphragm beneath the pleural reflection. There were 31 thoracoabdominal injuries in this series, an incidence of 24 per cent. The mortality of this group was 19 per cent, slightly lower than the general mortality of the entire series.

Thoracoabdominal lesions form the most frequent indication for major surgical invasion of the thoracic cavity by definitive thoracotomy. It is beyond the scope of this discussion to consider the indications for definitive thoracotomy in detail. Our present attitude may be summed up as follows. The repair of the diaphragm is much more readily accomplished from above and the repair achieved is likely to be much more secure. If there is a sucking wound or extensive dam-

age to the thoracic wall especially when the thoracic wound is below the 7th interspace affording satisfactory exposure of the diaphragm by extending the incision necessary to débridement of the wound the diaphragm is repaired from above. This approach is especially appropriate if the pathological condition likely to be encountered can be entirely repaired through an extension of the wound in the diaphragm. We have been gratified to find how readily subphrenic organs are approached by the transphrenic route. As has been previously stated the removal of the spleen is much more readily accomplished from above than from below and the same is obviously true of the approach to the gastric cardia and fundus and the entire posterior surface of the stomach. Nephrectomy can be accomplished readily through a low thoracic approach either on the right or the left. The splenic flexure of the colon is readily mobilized and externalized through a subcostal stab wound if perforated. The small intestine may be explored through the left diaphragm down to the distal reaches of the ileum.

Although there has been general agreement about the necessity for closure of the left diaphragm to prevent subsequent herniation, we are of the opinion that it is just as important to close the right diaphragm, if there is a lesion of any size in it, to prevent the drainage of bile into the pleura from the liver wound which is almost invariably associated with lesions of the right diaphragm. Continued flow of bile into the pleura produces an intense chemical pleuritis causing transudation of a great deal of fluid into the pleura requiring aspiration for a very long time. Total empyema is likely to result. The objection that the presence of the liver precludes exploration of the subhepatic areas has not proved a valid deterrent. Nephrectomy has been accomplished through the right diaphragm as readily as through the left. The liver may be retracted to the left, thus exposing the gall bladder the hepatic flexure and proximal transverse colon the duodenum and biliary tree.

The frequency with which the abdominal and the thoracic approach has been selected

TABLE VIII.—THORACO ABDOMINAL WOUND
ROUTE OF APPROACH—31 CASES

Route of approach	Cases	Died	Mort per
Thoracotomy alone	21	2	1
Celiotomy alone	4	2	5
Thoracotomy plus celiotomy	5	3	4
Not operated	1	0	
Total	31	6	1

is shown in Table VIII. In those cases which both thoracotomy and celiotomy may be done we have preferred to do the chest work first in order to restore the pulmonary physiology to as nearly normal as possible before proceeding to the more shockful celiotomy.

The phrenic nerve has been crushed whenever it seemed desirable to achieve phrenic paralysis to quiet the diaphragm and to favor its healing. This fact has seemed particularly indicated when there was an extensive wound of the diaphragm especially in those cases in which the diaphragm was avulsed near its origins for a considerable distance. Phrenic repair has usually been accomplished in two layers by overlapping the leaves of the diaphragm a centimeter and securing the closure with interrupted mattress sutures throughout. Every effort has been made to achieve rapid complete re-expansion of the lung following surgery. The most successful plan has been to institute water trap drainage of the chest through two tubes an upper one in the anterior 2nd interspace another in the posterior axillary line usually in the 7th interspace. The lung has been re-expanded under positive pressure by the anesthetist prior to completing the last sutures in the thoracotomy closure. The tubes have been removed after they have ceased to function when the lung has come out against them usually in 48 hours. In many instances the chest has remained completely dry (Case 7) although frequently from 1 to 4 daily aspirations have been necessary. Aspirations are continued until less than 50 cubic centimeters are obtained.

CASE 7. An American soldier aged 21 years was admitted 4½ hours after sustaining wounds of both chests from artillery fire not in shock with blood pressure of 130/70 pulse of 120. The missile had entered the right posterior chest over the 10th rib

just medial to the posterior axillary line and exited through the left chest fracturing the 8th and 9th ribs. This wound was sucking markedly. There was a small amount of blood in the gastric washings. The x ray film (Fig. 1a) showed the stomach herniated through the left diaphragm into the left thorax. Thoracotomy was performed by excising an additional length of the 9th rib. The fractured spleen was herniated with the intact stomach through a large rent in the diaphragm and there were several free fragments of spleen, comprising about half the spleen in the pleural cavity. The remaining spleen was not actively bleeding. Splenectomy was performed, reduction of the herniated stomach and repair of the diaphragm with two rows of interrupted cotton sutures. After the pleural toilet was completed the lung expanded readily with positive pressure except for the lower border of the lower lobe where there was a short laceration which was not bleeding. The chest was closed and a tube left in the 6th interspace in the posterior axillary line, another in the 2nd interspace anteriorly, both connected with water trap drainage. Debridement of the wound entrance with closure of the deep muscles over the small defect in the left pleura. The patient received 1 unit of plasma and 500 cubic centimeters of blood during the 70 minute procedure. Coagulability was smooth. Patient was sitting on the side of the bed eating a full diet on the 2nd post-operative day. X ray films of the chest 36 hours after operation show complete expansion of lung (Fig. 1b).

CHEMOTHERAPY

Enthusiasm for chemotherapeutics in the treatment of peritonitis in civilian practice has not been borne out by our experience in war surgery. The practice of administering sulfadiazine in tablet form as soon as possible after wounding is completely contraindicated in the man with a possible abdominal wound. Peristalsis and absorption cease abruptly at the time of wounding. The tablets frequently plug the gastric tube and are often recovered from the free peritoneal cavity. In an initial group of 18 cases we adopted a regimen of intensive sulfadiazine therapy giving 10 grams intravenously preoperatively instilling 10 to 15 grams of sulfanilamide crystals into the peritoneal cavity and continuing with 5 grams of sulfadiazine every 3 hours following operation. There remained cases of overwhelming contamination which were not apparently affected by this intensive therapy. We were also encountering a distressing number of renal failures and it was hard to be certain that acetylation of the sulfadiazine

with the deposition of crystals in the kidney was not a factor in producing this condition.

In April 1944, penicillin became available in sufficiently large amounts to warrant its use in cases of this type. Since that time we have used no sulfa drug. One hundred thousand units of penicillin were given intravenously preoperatively to every patient with likely intraperitoneal perforation of colon 25,000 units otherwise routinely. In those patients with severe contamination or established peritonitis, 100,000 units dissolved in 200 cubic centimeters of saline have been instilled into the peritoneal cavity through a catheter directed to the major areas of contamination just prior to finishing snug closure of the peritoneum. In all patients, regardless of the presence or absence of hollow viscus perforation 25,000 units have been routinely administered every 3 hours until the indication has no longer existed, frequently throughout the patient's 10 day stay in our unit. We have observed no difference in the patients who have received penicillin except that the associated soft tissue wounds have appeared cleaner. In cases of the same type patients have continued to succumb to their contamination. Renal failure has occurred with the same frequency. We suspect that if neither drug was available the result would be the same.

It should be pointed out in this connection that these views are not thoroughly concurred in by many surgeons working with these same types of cases, particularly because of the known inefficacy of penicillin in combatting the growth of *Escherichia coli* and its allied organisms. There is sufficient indication that the *Escherichia coli* is not the lethal organism in peritonitis, but rather that the clostridial and the anaerobic streptococci are. Since both of the latter are effectively combatted by penicillin, we have felt the objection to its sole use invalid. Clinical impression would seem to substantiate this view.

POSTOPERATIVE MANAGEMENT

If a shock state exists at the completion of surgery, the patient remains on the same litter on which he was operated upon in the deep

Trendelenburg position during the continuance of resuscitation. When all blood lost seems adequately replaced plasma infusion is continued slowly (40 drops per minute). Oxygen at 8 liters a minute is given usually by means of a soft intrapharyngeal catheter. Blood pressure and pulse readings are recorded by the nursing staff at half hourly intervals until stabilized at normal for a 2 hour period when the treatment is stopped.

Nasogastric suction is instituted through an indwelling gastric catheter of No. 18 F caliber when available. This suction is continued until audible peristalsis has been resumed usually about the 4th or 5th postoperative day even when there has been extensive contamination. It was early recognized that these patients stand the administration of electrolytic solutions poorly, tending to develop pulmonary edema. The following case is illustrative.

CASE 8. An American soldier aged 20 years was admitted 2 hours after sustaining a penetrating wound of the left flank and abdomen by small arms fire in profound shock, blood pressure and pulse unobtainable. Response to infusion of two units of plasma and 1500 cubic centimeters of blood was slow and the blood pressure 3 hours later was 70/40 although the pulse was 88. Operation was undertaken immediately. There was an estimated 3000 cubic centimeters of blood in the peritoneum only slightly contaminated. The gallbladder had entered through the leaves of the mesentery of the descending colon at about its midpoint perforating it tangentially extraperitoneally passed through the upper jejunum and entered the retroperitoneal tissues. There was a long laceration of the left common iliac vein which was bleeding briskly. The vein was doubly ligated above and below the rent. The jejunal perforation was closed and the descending colon exteriorized. Although 3000 cubic centimeters of blood was given during the procedure he was in severe shock at its close but over the next 12 hours blood pressure and pulse were stabilized within normal range of values. There followed 3 days of very satisfactory convalescence with slight fever although the pulse remained above 120 and there was moderate oliguria; the urinary output reaching 500 cubic centimeters on the second day. On the third day an hour after the completion of the infusion of 1000 cubic centimeters of dextrose-saline and 1 unit of plasma at 40 drops a minute over a 3½ hour period, he developed sudden severe dyspnea, cyanosis, diffuse moist rales over both lung fields and rapid thready pulse. Because of the sudden character of the onset the known injury to a great vein and the absence of dilatation of peripheral and neck

veins a sublethal pulmonary embolus was suspected. After temporary improvement, 13 hours later he developed fulminating pulmonary edema and died. The sole findings at autopsy were wet, edematous lungs and a markedly flabby edematous heart. There were no anterior clots in any of the great veins. The peritoneum smooth and glistening throughout and the jejunal perforation well closed.

This case is illustrative of the caution which must attend the administration of fluids to patients who have been in marked shock severe cardiovascular instability.

Departure was therefore made from the usual regimen of replacing fluid loss in the presence of gastric siphonage. No fluids are given until a 24 hour interval has elapsed after the recovery from shock and fluids are then begun cautiously. A drip apparatus introduced into the system and the administration rate kept at 40 drops a minute. One unit of plasma is added to each thousand cubic centimeters of dextrose solution to aid maintaining plasma proteins. After twenty-four hours hematocrit, plasma protein, hemoglobin and red blood cell determinations are made and the relative amounts of blood plasma given are guided by the presence of hemoconcentration or hemoconcentration. Careful records are kept of the urinary output so as to provide a further guide in the administration of fluids.

Pulmonary complications are particularly troublesome in this type of case and every precaution must be taken to prevent the accumulation of bronchial secretions, pulmonary atelectasis. The active measures taken to this end are:

1. Careful suction toilet of the tracheo-bronchial tree at the close of anesthesia with bronchoscopic suction if indicated.

2. Frequent turning of the patient manual support of the abdomen with insistence that he cough. The nursing and enlisted personnel on the wards have become particularly proficient in this maneuver.

3. Avoidance of excessive sedation depressing the cough reflex.

4. Frequent inhalation of pure carbon dioxide inducing hyperpnea and cough.

5. Early recognition of atelectasis by frequent examination of the patient.

thrombophlebitis likely. Every possible measure must be taken to prevent this complication, especially early and frequent change of position and as early mobilization as possible. We have recognized thrombophlebitis in only 2 patients of this group, and none has developed massive pulmonary embolus.

As soon as peristalsis has begun again and the duodenal tube is removed the patient is placed on a general diet. During the early postoperative period intravenous vitamin supplement is routinely administered ascorbic acid in 300 milligrams daily dose the B complex, and vitamin K. This therapy is continued by mouth as soon as it can be ingested. In spite of these measures there is usually visibly rapid nutritional depletion of the patient who may already have suffered considerable depletion resulting from long weeks in combat.

Early experience in the African campaign demonstrated that patients who have undergone major surgical procedures or who are suffering from peritonitis do not stand transportation within the first few days of operation. Ten days has been set as the minimum ideal time for evacuation. At the end of this time many are afebrile, eating a full diet, and have begun to sit in a chair beside their cots. Under the stress of a rapidly moving front, and occasionally when evacuation of the hospital has been forced by enemy shell fire it has been necessary to evacuate patients earlier. The average time for evacuation of this entire series was 10 to 7 days.

DISCUSSION

This opportunity to observe the pathology and altered physiology produced by the rapid flooding of the peritoneal cavity with the content of colon or terminal ileum has brought to our attention a pattern of events so uniform in their fatal characteristics that we prefer to speak of it as the syndrome of overwhelming contamination. Typically the patient is admitted in a shock state which responds slowly and incompletely to replacement therapy. When the peritoneal cavity is opened there is a large amount of foul smelling fecal stained blood. The peritoneum is stained a purplish brown has a grayish cast

is lustreless and there are areas of intense hyperemia particularly over loops of small intestine. Fibrin deposition has not as yet begun. The patient usually goes into deep shock during the operation from which his recovery is slow and frequently never complete. In spite of the continuance of plasma administration, he develops an intense hemoconcentration with evidences of markedly slowed circulation of the peripheral capillaries. The blood pressure gradually falls the pulse rate rises, and death occurs in the first 24 hours. In those patients who survive for a longer period reaching the 3rd or 4th day there is invariably pulmonary edema. Large amounts of frothy fluid well into the trachea which they are too weak to cough up and which it is difficult to remove sufficiently well by intratracheal suction. Fever is rarely high before death occurs between the 3rd and 5th postoperative days. At autopsy one is especially impressed with the fact that the peritonitis has continued to improve. In fact in certain cases there is the very minimal evidence of peritonitis—a few areas of peritoneum that have lost their sheen a few flecks of fibrin. Unless there is continued leakage into the peritoneum a true fibrinopurulent peritonitis is not seen. In certain of these cases peristalsis may have been re-established prior to death diet tolerated and the colostomy may have begun to function. The major gross pathology is in lungs and heart. The lungs are intensely wet, water logged the bronchi full of thin frothy fluid. Certain areas of atelectasis and pneumonitis may be present but the picture is chiefly one of edema rather than pneumonia. The heart is invariably very edematous chiefly in the subepicardial layers, the myocardium pale and flabby the entire heart dilated especially the right ventricle.

There occur certain instances in which there is massive spillage of colon content in which there is not this peritoneal staining. Usually the feces is solid in these patients. There is usually intense hyperemia of the peritoneum and a puriform exudate with little odor. These patients live. The others die. Although it is undoubtedly important it would seem that the picture bears little

abdominal cases than in other severe injuries. The one most striking feature seems to be that almost all have been for long periods in extreme hypotension states. They have therefore received large amounts of blood in the resuscitation. Only a few have shown clinical evidences of transfusion reaction and in these there has been extensive hemolysis in plasma and urine typical of transfusion reaction. Detailed studies are now being made on the problem. We feel that it has little relationship to the administration of blood and prefer to call it "shock kidney."

Further reduction in the mortality of the abdominal wounds of warfare depends chiefly upon the solution of these two problems.

SUMMARY

1 Experience in the initial surgical care of 130 war wounds of the abdomen is presented. The mortality in our hands was 23.4 per cent.

2 Diagnosis is chiefly a problem of reconstructing the course of the missile. The usual signs of peritoneal irritation are reliable. The presence of peristalsis rules out intraperitoneal perforation of hollow viscus.

3 It is profitable to operate on every patient with an abdominal wound regardless of time lapse or risk.

4 Exploratory celiotomy is rarely necessary.

5 The degree of shock on admission is the most reliable prognostic sign.

6 Severe fecal contamination of the peritoneum produces a clinical picture impossible to differentiate from shock. These patients respond slowly or not at all to replacement therapy.

7 Shock treatment is continued as long as improvement continues. It is rarely profitable to give more than 1500 cubic centimeters of blood prior to operation.

8 Ether-oxygen anesthesia by closed ab-

sorption endotracheal technique is the anesthetic of choice.

9 Although the function of the surgeon is primarily to save life it is rarely necessary to adopt compromise procedures.

10 Resection of small bowel is preferable to multiple closures within a short segment which may distort and lead to obstruction.

11 Exterionization of the wounded colon is the safest procedure. Perforation of the colon remains the single most lethal factor in any series of abdominal wounds.

12 Adequate drainage of liver wounds is essential. Liver packs are rarely if ever, necessary and are productive of complications.

13 Solid viscera including the spleen, do not continue to bleed significantly from their parenchyma.

14. Intractable bleeding from a hilar vessel and division of the ureter form the sole indications for removing the wounded kidney.

15 Closure of the diaphragm is as important on the right as on the left.

16 Penicillin is no more effective than the sulfanilamides in preventing death from severe contamination of the peritoneum.

17 Intravenous administration of isotonic electrolytic solutions postoperatively is poorly tolerated by the patient recovering from a severe shock state or combatting peritonitis.

18 Pulmonary complications must be anticipated and vigorously treated.

19 Overwhelming contamination of the peritoneum and renal insufficiency remain the two problems the solution of which must precede marked further reduction of mortality from abdominal wounds.

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THE EFFECTS OF PEDICLE JEJUNAL TRANSPLANTS IN THE STOMACH ON MANN-WILLIAMSON DOGS

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ANDRUS Lord and Stefko reported that when pedicle grafts of the jejunum were transplanted into the stomach wall of dogs a reduction in gastric acidity ensued. In such animals following histamine injections there was a reversal or considerable diminution in the expected rise in acidity. These results were obtained particularly with jejunal transplants, although a duodenal flap caused similar changes but in a lesser degree. No effects were produced with ileal or colonic segments.

They then produced gastroduodenal ulcers by the injections of histamine-beeswax mixture after the method of Varco. Jejunal transplants into the stomach had a salutary effect on these ulcers. In 3 dogs previously prepared with grafts, no ulcers formed after histamine-beeswax injections.

Applied to humans (3) jejunal flap transplants were done in 4 peptic ulcer cases. Hyperacidity was reduced in 3 of these patients and clinical improvement without change in acidity was noted in the fourth patient.

In ulcers produced by the histamine-beeswax method the beeswax is imbedded in the subcutaneous tissues. The secretagogue effect of the histamine causes continuous gastric hypersecretion. Chronic ulcers form in the stomach or duodenum in 100 per cent of cases.

Another standard method of producing chronic duodenal ulcers in dogs is the Mann-Williamson operation (6). In this procedure the stomach is made to empty into the jejunum and the alkaline duodenal bile and pancreatic juices are diverted into the terminal ileum. Acid gastric juice thus spurts constantly against an area of jejunum unprotected by its normal alkaline juices.

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We have done the Mann-Williamson operation on 28 control dogs whose diet consisted of left overs from the hospital kitchen. In all cases (100%) jejunal ulcers were demonstrated at necropsy. The survival time averaged 71 days. The minimal time from operation to expiration was 13 days, and the maximum 135 days (7).

We wish to report our observations on 6 Mann-Williamson dogs in which jejunal pedicle graft transplants were done (Table I). These operations were done in one or two stages.

TECHNIQUE

Intravenous nembutal anesthesia was used. The abdomen was opened through a midline incision. A segment of jejunum $1\frac{1}{2}$ to 2 inches long and 3 to 4 inches from the ligament of Treitz was isolated and divided. Meticulous attention was given to the integrity and adequacy of the attached mesenteric blood supply.

The posterior wall of the stomach was then delivered through a rent in an avascular portion of the mesocolon and serosal sutures were placed joining the prepared section of jejunum to the stomach. The cylinder of jejunum was then incised at its antimesenteric border and the edges were trimmed, thus forming a flap. A gastric window was fashioned to accommodate the jejunal patch, and the pedicle graft was secured in place with two rows of sutures usually silk throughout.

When the jejunal transplant was done as a first stage or preliminary procedure, the continuity of the jejunum was then re-established either with a side-to-side or end-to-end anastomosis, and the abdomen was closed.

The second stage consisted of the typical Mann-Williamson operation. The stomach was divided at the pylorus, and the duodenal end was inverted and closed. The jejunum was sectioned about 1 inch distal to the previous anastomotic site. The open pyloric end of the

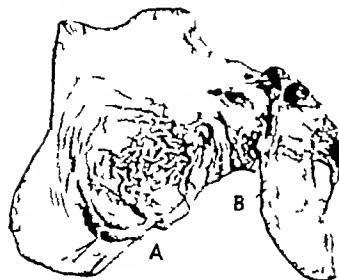


Fig. 1a



Fig. 1b



Fig. 1c



Fig. 2a



Fig. 2b



Fig. 3

Fig. 1. Dog No. 225. One stage jejunal pedicle graft and Mann-Williamson operation. death in 32 days. a, Pedicle graft viable, A jejunal ulcer B b Closeup of ulcer c, Microscopic appearance of jejunal ulcer

Fig. 2. Dog No. 208. One stage jejunal pedicle graft and Mann-Williamson operation. death in 64 days. a, No jejunal ulcer A, well defined penetrating ulcer jejunal transplant. b Microscopic section through ulcer in center of transplant. Note necrotic superficial layer of ulcer and normal appearance of blood vessels in base of transplant.

Fig. 3. Dog No. 224. One stage operation. death in 86 days. perforated jejunal ulcer with evidence of fresh intra-

peritoneal hemorrhage. Autopsy appearance perforated jejunal ulcer with fresh hemorrhage, B, under surface of diaphragm (torn) 1 liver 2 stomach (pyloric end anastomosed into jejunum) 3 closed stump of duodenum 4

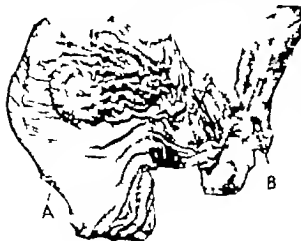


Fig. 4a



Fig. 4. Dog No. 24. Same dog as Figure 3. a, Pedicle flap, A perforated jejunal ulcer B not marked jejunal flap. b, Cross section of vascular pedicle of jejunal flap note normal appearance of blood vessels. c, Section of II of pedicle flap I stomach not blood supply and normal appearance of II layers.

stomach was anastomosed into the distal jejunal segment. The proximal jejunum was then joined to the terminal ileum (8 to 10 inches from the ileocecal junction) thereby providing the surgical duodenal drainage. Anastomoses were generally side-to-side or end-to-side occasionally end-to-end. Silk was used throughout. The two stage operation was done in 3 dogs. The interval between the 2 operations was 25, 29 and 47 days, respectively.

Because of the technical difficulties of adhesions encountered when the abdomen was

entered a second time the two procedures were combined in one operation in 4 animals. When thus performed the pedicle graft was fashioned into the posterior stomach wall first. Then the stomach was divided at the pylorus and the duodenum was closed. The open ends of the jejunum where the transplant has been removed were then used for the Mann-Williamson anastomoses, the distal one for the pyloric end of the stomach, the proximal one joined to the terminal ileum.

TABLE I—RESULTS

Dog	Surgery	Survival time—days	Autopsy findings	Laboratory data				Days before euthanasia
				H. ions %	Hgb %	R B C	W B C	
5 (Fig. 1)	One stage jejunal pedicle graft and Mann-Williamson 2-29-44	36	Superficial jejunal ulcer pedicle graft visible	30	5	1,450	1,400	
208 (Fig. 2)	One stage operation 7-44	41	No jejunal ulcer. Well defined ulcer of pedicle transplant. Pedicle blood supply O.K.	40	60	1,450	1,000	
24 (Fig. 3) (Fig. 4)	One stage operation 8-7-44	86	Perforated jejunal ulcer (fresh rupture), small tumor tags. Pedicle transplant O.K.	50	49	1,150	1,950	5
204 (Fig. 5)	Two stage operation Pedicle graft jejunum w/ stomach 44 Mann-Williamson 30-44	54 24	Two superficial jejunal ulcers. Pedicle graft O.K.		31	1,400	18,400	
205 (Fig. 6)	Two stage operation Pedicle graft 44 Mann-Williamson 28-44	57 3	Deep jejunal ulcer, 14 cm diameter. Pedicle graft O.K.	13	40	1,150	4,650	2
8 (Fig. 7)	Two stage operation Pedicle graft 2-12-44 Mann-Williamson 4-29-44	26 79	Two deep jejunal ulcers, one with perforation. Pedicle graft O.K.					



Fig 5a.



Fig 6

Fig 5 Dog No. 204. Two stage operation first stage jejunal transplant, second stage Mann-Williamson operation 35 days later; death 38 days after operation. a, Jejunum transplant, A, two large eroding jejunal ulcers, B C b, Microscopic section through ulcer B

Fig 6 Dog No. 205. Two stage operation jejunal transplant, Mann-Williamson operation 15 days later; death 43 days after operation. Jejunum transplant, A jejunal ulcer $1\frac{1}{2}$ centimeters in diameter B

RESULTS

In Table I it will be noted that despite pedicle jejunal graft transplants all dogs except one developed jejunal ulcers. The one exception dog No 208 developed an ulcer of the jejunal pedicle transplant (Fig 2). The ulcers were identical with the ones we have been accustomed to seeing with control Mann-Williamson dogs. The photographs show this clearly. There are superficial ulcers penetrating into the muscularis, and ulcers which have perforated completely. They form in the identical location— $\frac{1}{2}$ centimeter beyond the pylorojejunal anastomosis or slightly distal to this point as they did in our



Fig 5b

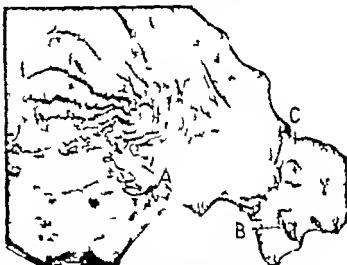


Fig 7

Fig 7 Dog No 182. Two stage operation jejunal transplant and Mann-Williamson operation 18 days later; death 51 days after operation. Jejunum pedicle graft, A two deep jejunal ulcers, B C one of which, B has perforated.

controls. Two of the photographs show that the blood supply at the base of the transplant (and also in the vascular pedicle) is intact.

The survival time average, 70 days was about the same 71 days as in our control animals.¹

CONCLUSION

The healing and prophylactic effects attributed to the jejunal flap in dogs with histamine induced ulcers were not evident in 6 dogs with

The seventh experiment was not completed at the time this paper was submitted. It was one stage operation done on December 30, 1944. The dog was sacrificed August 7, 1945, (8 months later) at which time there was 25 per cent weight loss and the dog was almost moribund. Autopsy showed large well nourished pedicle graft. The jejunum showed no ulceration (Fig. 8). Since this was one of the larger jejunal grafts, further work will be done using even larger transplants.

the Mann-Williamson ulcers. Ulcers formed eroded and perforated in spite of viable grafts. The seventh dog was sacrificed 8 months after operation. There was no ulcer present in this animal.

NOTE: Since this work has been completed, two articles have appeared testing the value of pedicled jejunal transplants on gastric acidity. Kolouch, Dubuc and Wangenstein reported that the histamine effect was not reversed in pedicle transplant dogs, as Andrus and associates had found. Also, when daily intramuscular injections of histamine in beeswax were given, the jejunal transplant showed reduced resistance and invariably ulcerated in the presence of this induced continuous gastric hypersecretion. Using Heidenhain's pouch dogs, the pedicle graft caused slight but inconstant depression of gastric acidity, but it did not regularly inhibit gastric secretion from the pouch and gastric juice from such pouches as irritating as normal gastric juice when delayed out exteriorized duodenal mucosa.

Crossman, Dutton, and Ivy also tested the gastric acid secretory response to histamine stimulation in pedicle jejunal grafts. They found no significant change.

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PRIMARY CARCINOMA OF THE FALLOPIAN TUBES

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PRIMARY carcinoma of the fallopian tubes is a rare disease. Its infrequent occurrence is especially evident when it is compared with the rather frequent incidence of malignant neoplasia in the uterus and the ovaries which, with the tubes originate from the muellerian duct. Moreover the clinical manifestations of tubal carcinoma are so protean that the internist rarely arrives at a correct diagnosis even when the process is far advanced. At the operating table the surgeon often is confused by the appearance of hydrosalpinx and may fail to realize that a distended condition of the fallopian tubes may obtain on a malignant basis. He consequently may be led to carry out an inadequate sacrifice of tissues. Even the pathologist has difficulty in differentiating from carcinoma of the tubes such divergent lesions as adenomyosis and tuberculous salpingitis. In consideration of the aforementioned facts and the added knowledge that primary tubal carcinoma carries an extremely bad prognosis attempts made along the line of establishing criteria for early diagnosis of the condition would seem to fulfil a worthy purpose. Our contribution consists of a review of the literature and the clinical and pathologic analysis of 16 cases of primary carcinoma of the fallopian tubes seen and studied at the Mayo Clinic in the past 40 years.

HISTORICAL DATA

Orthmann in 1888 described what is now generally accepted as the first authentic case of primary carcinoma of the fallopian tube. Although he collected, reviewed and accepted 13 earlier examples from the literature examination of these cases in the light of more recent knowledge leads to the belief that they were instances of metastatic rather than of

primary involvement. Doran(6) in 1888 recorded the second well established example and expressed the opinion that the growth had its origin in a benign tubal polyp. Kaltenbach in 1889 reported the third case and described the papillary and alveolar pictures which are now almost standard in descriptions of the microscopic appearance of the lesions. Rouzier in 1893 and Tuffier in 1894 furnished the fourth and fifth cases respectively according to Holland. In 1901 Le Count was able to review 21 cases from the literature and to point out the frequent association of hyperplastic salpingitis as a possible etiologic factor. In 1911 von Franqué emphasized the frequent occurrence of tuberculous salpingitis as a precursor of tubal carcinoma and this was again stressed by L. Esperance in 1917 in a review of 49 cases of primary carcinoma of the fallopian tube accumulated from the literature. L. Esperance described a case of epidermoid carcinoma of tubal origin a type of lesion first recorded for this location in 1916 by Barrett. The number of authentic examples of primary tubal carcinoma had reached the hundred mark in 1910 when Doran(7) supplemented his original report. Along with Orthmann and Vest this investigator pointed out the difficulties of diagnosis, the tendency toward early dissemination and the gloomy prognosis. Vest stated that surgical operation offered a little less than a 4 per cent chance of cure. With stimulated interest in the subject, reports of individual cases of this rare disease found their way into the literature so that Kahn and Norris in 1934 were able to collect published data on 323 cases. This number was increased to 427 when Mullins and Mosteller reviewed the subject in 1942. With the cases published in the past 2 years added to those of the present series the accumulation has now reached 450.

MATERIAL AND METHODS

The investigation of the material for the present study began with a search of the files of the Mayo Clinic for cases in which car-

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Abstract of thesis submitted by Dr. Lofgren to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirement for the degree of M. S. in Surgery.

Since this paper was written Dr. Lofgren has entered the armed services and is now Lieutenant in the Medical Corps of the United States Army.

cinoma involved principally the fallopian tube or tubes. Forty two such cases had been encountered over a 34 year period from 1910 to 1943 inclusive. The pathologic specimens, removed surgically or at necropsy, were all available and were inspected grossly to exclude those cases in which the tubal involvement was obviously metastatic in nature. Excluded also were those cases in which massive involvement of the pelvic viscera made it unlikely that the matter of primary tubal origin of the malignant growth could be decided with certainty. Selected for further investigation were specimens in which the involvement was strictly limited to the tubes and a second doubtful group in which although concomitant involvement of the uterus and ovaries was present, it appeared to be grossly of a metastatic nature. No cases in which the tubal mucosa remained intact were accepted for study. In every instance multiple blocks of tissue were removed from involved and uninvolved portions of the tube and from the associated ovarian and uterine lesions when the latter were present. These blocks were placed in a fresh 10 per cent solution of formaldehyde (3.7 per cent commercial formalin) sectioned at 7 microns with a freezing microtome and stained routinely with hematoxylin and eosin. In cases in which mucus seemed to be present in sections stained by the aforementioned method sections cut from paraffin blocks were stained with mucicarmine. The microscopic finding of psammoma bodies and of papillary mucous carcinoma, when tubal and ovarian lesions coexisted was considered as being fair evidence that the primary lesion was in the ovary. Similarly the finding of adenocarcinomatous zones in a lesion involving the uterus and the tube or tubes was conceded as indicating a uterine origin. Discarded along with these samples after careful microscopic study were 2 specimens of tubal tuberculosis with epithelial hyperplasia. A residue of 16 cases of true primary tubal carcinoma remained to serve as a basis for this report.

CLINICAL AND PATHOLOGIC DATA

Incidence. Sixteen primary carcinomas of the fallopian tube were found in approxi-

mately 10 000 patients suffering from primary malignant lesions of the female generative tract an incidence of 0.16 per cent. Stuebler and Brandess in a comparable analysis found an incidence of 0.45 per cent. Anspach found only 1 instance of primary tubal carcinoma among 19 439 patients admitted to the gynecologic service at the University Hospital in Philadelphia.

Age. The average age of our 16 patients was 50.9 years with extremes of 34 and 65 years. Nine of the 16 patients had passed the menopause. In the literature 18 and 80 years represent the extremes of age for patients suffering from the effects of primary carcinoma of the fallopian tube. According to Wechsler 66 per cent of the patients affected are between the ages of 45 and 55 years almost a decade prior to the peak incidence seen in cases of uterine (fundal) carcinomas.

Symptoms. The commonest complaint was vaginal discharge. This was present in 10 of the 16 cases and in 7 it was the principal symptom. Duration had varied from 3 days to 1 year with an average of about 5 months. In postmenopausal patients the discharge was constant and in younger women it was described as being intermenstrual. The character of the discharge varied from leucorrhea to frank bleeding. In only 1 instance was it described as malodorous. In 1 case the discharge had continued without interruption following curettage of atrophic endometrium. Throughout the literature this phenomenon namely persistence of discharge following curettage has been repeatedly emphasized as being characteristic of the vaginal discharge associated with tubal carcinoma as opposed to other lesions causing this symptom (22-30). According to Anspach other characteristics of this symptom include the occurrence of the discharge in sudden gushes accompanied by paroxysms of cramp-like pain a phenomenon to which the term *hydrops tobæ profuens* has been applied.

Pain in the lower portion of the abdomen usually on the side of tubal involvement was the second commonest symptom and it was a major complaint in 8 of the 16 cases. In 1 case constant, dull pain had been present for 15 years. It probably was related to the

chronic pelvic inflammatory condition associated with the tubal carcinoma. In the other 7 cases the pain was usually of shorter duration than the vaginal discharge. The pain was crampy and intermittent in character in 6 of these 7 cases and seemed to be related pathologically to distention of the affected tube produced by the expansion of the malignant growth. In 1 case however the pain took the form of an acquired dysmenorrhea and it was accordingly impossible to correlate etiologically with the pathologic lesion in the fallopian tubes. Pain was a prominent symptom in 53 per cent of the cases of tubal carcinoma analyzed by Doran. Fullerton felt that it was produced by stretching of the muscular coats of the tubal wall.

Three patients complained of lower abdominal swelling which had been present for from 3 weeks to 2 years. In 1 of these cases the swelling appeared to obtain on the basis of the size of the carcinoma *per se* whereas in the other 2 the presence of associated hematosalpinx augmented the bulk of the tubal neoplasm. In the literature this symptom is listed along with vaginal discharge and pelvic pain as completing a triad frequently based on the presence of primary tubal carcinoma.

Symptoms of a miscellaneous nature commonly found among women suffering from various gynecologic lesions included backache a bearing-down feeling constipation dysuria frequency menometrorrhagia and so forth. In our series they did not occur in any combination or in any sequence which could be interpreted as being diagnostic of the underlying tubal disorder.

Physical findings. In 14 of the 16 cases masses were demonstrated on pelvic examination. These were described as varying from 4 to 15 centimeters in average diameter and were generally nontender. The right side was given as the location in 5 instances the left in 1 and in 1 bilateral masses were palpated. An anterior and a posterior relation to the uterus were described in 2 cases each and in the remainder the lesion was either too large or too ill defined for more accurate localization than that denoted by the term pelvic. In about half of the cases the masses seemed movable whereas fixation of

varying degrees characterized the rest of the tumors. One of the patients was suffering from the effects of an abdominal sinus tract which had developed after an operation elsewhere for pelvic inflammatory disease. Carcinomatous tissue curetted from this sinus tract suggested the diagnosis of primary tubal carcinoma but in none of the other cases was the true nature of the lesion suspected clinically as one would expect from lack of specificity of symptoms and results of examination. In the literature although primary tubal carcinoma is productive of palpable pelvic masses the diagnosis is established preoperatively only through the medium of unusual circumstances such as that just cited. Falk in 1898 established it in 1 case by examination of material aspirated through the cul de sac by means of a needle and syringe. Martzloff in 1940 duplicated the feat by finding atrophic endometrium in a woman who complained of a watery vaginal discharge and who had a right adnexal mass which was demonstrated on pelvic examination.

Surgical findings. The gross appearance of primary tubal carcinoma as seen at the time of surgical exploration was often deceptive. In 6 instances the involved tubes were distended particularly at their fimbriated extremities the condition resembled hydrosalpinx pyosalpinx or hematosalpinx. In these 6 cases no adhesions and no carcinomatous implants were present and the true nature of the lesion was not suspected until the tubes were opened in the laboratory. In 4 cases unilateral or bilateral tumor masses had produced adhesions to neighboring structures such as the uterus the sigmoid the cecum or loops of small intestine. In this group there was a marked resemblance to chronic tubo-ovarian inflammatory disease. In the remaining 6 cases the correct diagnosis was anticipated by the finding of adhesions near the growth plus malignant appearing implants on the surface of the corresponding or the contralateral ovary the posterior surface of the uterus the sigmoid or the cecum. In 2 cases the corresponding broad ligament was infiltrated by carcinomatous tissue. One of the patients had associated ascites which appeared to obtain on a malignant basis. The operative

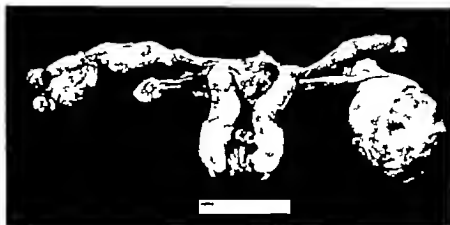


Fig. 1. Encapsulated small carcinoma primary in right tube. The fibrotic ex-
tremity of the tube has become occluded and the general similarity to pyosalpinx
is apparent. The right ovary is atrophic and the left contains a dermoid cyst.



Fig. 2. Poorly encapsulated primary carcinoma of the left fallopian tube. A small
ovarian implant is indicated.

procedure in these 16 cases was hysterectomy with bilateral salpingo-oophorectomy because of the laboratory diagnosis of tubal carcinoma from fresh tissue. In 2 cases dissection of pelvic lymph nodes also was performed. In 2 cases an attempt was made to remove local peritoneal implants but in only 10 cases was the surgeon at all satisfied that he had eradicated the gross evidences of malignant disease.

Pathologic data. Gross appearance. The right fallopian tube was involved in 8 and the left in 7 cases. The incidence of bilateral involvement was 6 per cent, about a quarter that reported in the literature. The size of the lesions varied from 20 by 15 by 10 centi-

meters to 2 centimeters in average diameter. The size of several of the larger lesions seemed to be augmented by the presence of associated hydrosalpinx or hematosalpinx. As indicated in the foregoing 6 of the lesions were encapsulated whereas the remainder were adherent and frequently demonstrated carcinomatous extension in the form of superficial nodules or distant implants. For the most part the growths seemed to involve the outer or more distensible portions of the tube (Figs. 1 and 2). From 1 of the carcinomas a sinus tract lined by malignant tissue had extended from the right fallopian tube to the anterior abdominal wall. Hematosalpinx was found in 3 hydro-



Fig 3. Primary squamous cell epithelioma, grade 3 of the left fallopian tube. The pathologic mitosis (upper left) the absence of pearly bodies, and the general variability in the size of the cells and of the nuclear staining are indicative of rapid growth. Hematoxylin and eosin stain $\times 251$



Fig 4. Primary papillary adenocarcinoma, grade 1 of the right fallopian tube. Papillary projections are delicate and covered by one or two layers of hyperchromatic tumor cells which however appear to be fairly well differentiated. The psammoma body (dark) is a rather unusual finding. Hematoxylin and eosin stain $\times 63$

salpinx in 2 and pyosalpinx in 2 of the involved tubes. In the remainder the tubal distention obtained on the basis of proliferating carcinomatous tissue per se. Grossly this tissue appeared to be papillary in 8 of the tumors whereas in the remainder no particular gross architecture was manifest, the tissue being grayish red soft friable and frequently necrotic. In 6 tumors a superficial attachment to the capsule was noted but in the remainder there was evidence of invasion with peritoneal involvement in 8. Uninvolved portions of the tubes appeared grossly to be thickened and inflamed. Subacute and chronic salpingitis affected the contralateral fallopian tube in 10 of the cases exclusive of the one in which the malignant lesion was bilateral. Watkins and Wilson remarked on the close resemblance between tubal carcinomatous and inflammatory lesions. In both the ostium of the tube tends to become occluded or attached to the homolateral ovary with the formation of a tubo-inflammatory mass. In this way spillage of carcinoma cells may be averted until the growths are large (23).

Associated ovarian pathologic lesions consisted of malignant implants in 2 cases, dermoid cyst in 1 case, simple cysts in 2 cases and perioophoritis usually of the homolateral ovary in 6. The uterus harbored peritoneal implants in 3 cases and in 5 were the seat of multiple fibromyomas. In this series no

metastasis to the endometrium was encountered as reported by Thaler, Bower and Clark, Ries, Mueller and von Franqué.

Microscopic features. The microscopic features found in our cases of primary tubal carcinoma differed in no major respects from those described in standard treatises on the subject (6, 7, 12, 15, 16) and will be described only briefly. The essential composition was that of epithelial cells which were short, columnar to cuboid and devoid of cilia. Nuclei were large and hyperchromatic with prominent nucleoli and mitotic figures whose frequency in general paralleled the degree of dedifferentiation of the tumor cells. According to the classification and method of grading devised by Broders one of the tumors was epidermoid carcinoma grade 3 (Fig 3) whereas the remaining 16 tumors (1 bilateral) were classified as adenocarcinomas. The degrees of dedifferentiation in this adenocarcinoma group were such that in 1 tumor it was graded 1, in 10 graded 2 and in 3 graded 3. The remaining 2 tumors were of a grade 4 order of malignancy. The lesions of grade 1 and grade 2 malignancy were practically all papillary with single or double layers of fairly well differentiated tumor cells investing the surfaces of delicate connective tissue cores which provided coarse finger-like or delicate filamentous supporting trellises (Fig 4). These lower grade neoplasms did not appear to be as



Fig. 5. Alveolar adenocarcinoma, grade 3, of the fallopian tube showing cellular anaplasia, poor alveolar formation and invasion of the muscularis. A foreign body giant cell is present in large rim. Hematoxylin and eosin $\times 45$.

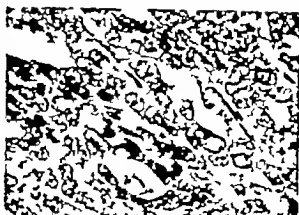


Fig. 6. Mucocarcinoma, grade 4, of the right fallopian tube. Cellular atypia, nuclear hyperchromatism, many mitotic figures indicate anaplasia. A poorly formed acina space just above and to right of center is all that indicates glandular origin. Hematoxylin and eosin $\times 55$.

infiltrating as the others. In the lesions of grade 3 and 4 malignancy the picture corresponded to the alveolar pattern described in the literature (Fig. 5). Here papillary formations were for the most part absent and only poor glandular formation was apparent. Mitotic figures were numerous and frequently atypical forms were seen. Giant tumor cells perivascular growth, the occurrence of zones of necrosis and the plugging of lymphatic spaces (2 cases) and blood vessels (1 case) bespoke marked degrees of malignancy (Fig. 6). In 8 of the cases the entire growth appeared to be localized within the confines of the stretched-out tubal peritoneum whereas

in the remainder there was evidence of extension with frequent involvement of what the surgeon described as surface adhesions.

In common with other investigators we found an almost 100 per cent incidence of subacute or chronic inflammatory changes in the so-called normal portions of tubes that were the seat of carcinoma. However we were unable as a result of our studies to decide whether the carcinoma developed secondarily or whether the inflammatory process represented a reaction to the necrosis resulting from the breakdown of malignant tissue. The former possibility has been proposed and it is supported by (1) the occurrence of carcinoma in the ampullary portion of the tube which is the seat of election for the development of tubal inflammation and (2) the finding of hydrosalpinx, pyosalpinx, and hematosalpinx in the contralateral tube as noted in 9 of our cases.

The concomitant occurrence of tubal tuberculosis and tubal carcinoma has been emphasized in the literature (8, 10) and an etiologic relation has been postulated. However it is well known that tuberculous salpingitis is frequently productive of marked epithelial hyperplasia often with the formation of papillary and alveolar configurations. The appearance may suggest carcinoma and indeed in 2 of our earlier cases the condition had been so labeled. These 2 cases were eliminated from our series because although the archi-



Fig. 7. Tubal tuberculosis illustrating the concomitant epithelial hyperplasia. Such sometimes misguides the pathologist to making the additional diagnosis of carcinoma. Hematoxylin and eosin $\times 8$.

ture when seen under low power magnification suggested a malignant process associated with tuberculosis examination under high magnification failed to reveal cellular atypia mitotic figures lymphatic invasion and the other criteria of malignancy which were so prominent in other cases (Fig 7) In 1 of our cases tuberculous salpingitis involved the contralateral fallopian tube

None of the tumors seemed to arise in connection with tubal endometriosis. Tubal adenomyoma was demonstrated in 1 of our specimens but at some distance from the carcinoma Work and Broders (5 31) have shown that tubal adenomyomas involve principally the uterine or isthmic portions of the tube and that the lesions are nearly always bilateral The location and distribution of these lesions are accordingly unlike that of primary carcinoma of the tube No etiologic relation between tubal polyps and tubal carcinoma was evident from the examination of our material

End results of treatment Two of 16 patients are living 10 and 14 years after operation In both of these cases the lesions were small and there was no extension beyond the presence of an ovarian nodule in 1 case in which the ovary was attached to the fimbriated end of the tube Nine of the patients are known to be dead The average postoperative survival in this group was 18 months with extremes of 4 months and 5 years All grades of malignancy were represented in this group with the duration of survival being generally longer when the grade of the tumor was low rather than high Postoperative roentgen therapy appeared to delay the fatal outcome in 1 of these 9 patients. Four of the patients have been operated on too recently to permit conclusions as to prognosis but the presence in 2 of peritoneal implants does not suggest a happy prospect The 16th patient has not been heard from It is accordingly apparent in our series that primary tubal carcinoma carries a gloomy outlook from the standpoint of successful treatment. A high grade of malignancy the presence of peritoneal metastasis and the finding of malignant invasion of lymphatic spaces and of blood vessels appeared to be unfavorable features.

SUMMARY AND CONCLUSIONS

Primary carcinoma of the fallopian tube is a rare condition which accounts in our experience for only 1 out of every 625 carcinomas of the female genital tract. For the most part it is a disease of the menopause and has not been reported among individuals in their prepuberal years Symptoms are insidious in their onset with vaginal discharge pelvic pain and abdominal tumor representing cardinal symptoms which however rarely lead the physician to a correct preoperative diagnosis. The evolution of the disease is more rapid than is indicated by its symptomatology and the majority of patients so afflicted demonstrate lesions of doubtful resectability at the time of surgical exploration The appearance of the lesion on gross inspection is sometimes deceiving since it may mimic closely familiar tubal conditions of an inflammatory nature Because of this every distended fallopian tube should be opened before it is removed from the operating room Treatment of these carcinomas whenever found regardless of any apparent state of encapsulation should consist of total abdominal hysterectomy with bilateral salpingo-oophorectomy in addition to removal of any discernibly involved regional lymphatic nodes and peritoneal implants. Postoperatively roentgen therapy should be administered In spite of these measures the number of 5 year cures is disappointingly small Pathologists who are unfamiliar with the condition will often have difficulty establishing the primary nature of the lesion and should remember that the fallopian tubes are frequently involved in metastasis from ovarian and uterine sources. Actual involvement of the tubal mucosa strict confinement to the fallopian tube a marked disproportion between the size of the tubal and extratubal lesions as well as a working knowledge of the histologic pictures of primary uterine tubal and ovarian carcinomas will be helpful in deciding the primary source in doubtful cases The epithelial hyperplasia associated with tuberculous salpingitis should be kept in mind and the diagnosis of tubal tuberculosis and carcinoma should not be made except when malignant neoplasia is manifestly indicated

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SPONTANEOUS RUPTURE OF THE SPLEEN

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SPONTANEOUS rupture of the spleen a serious condition which demands careful clinical evaluation and prompt surgical intervention is relatively uncommon and therefore may be difficult to diagnose. In the hope of stimulating interest in this subject 3 cases are presented to demonstrate this difficulty in diagnosis. Two of the cases are from personal experience and the third is reported from a clinical summary received from another hospital.

CASE 1: An enlisted man, 19 years old, was admitted to the hospital on August 17, 1943. He had served in the Army 4 months. His home was in Philadelphia, Pennsylvania. He complained of vague basal headaches, abdominal pains, and a cold. The headaches, which started soon after he was inducted into the Army, would last from 1 to 12 hours and would then disappear. He had rarely ever had a headache before induction. During these attacks his stomach was upset and he could not tolerate food. In addition he complained of shortness of breath. There was nothing significant in his past history. He was slender, 6 feet tall, and weighed 130 pounds. He had mild acne, his nose, nasopharynx, and tonsils showed a mildly acute infection. His chest and cardiovascular system were normal, the blood pressure being 110/64. The only positive findings were a generalized lymphadenopathy and an enlarged spleen. No abdominal tenderness was noted. Infectious mononucleosis was suspected and ruled out. The Wassermann test for syphilis was negative. The initial impression, as noted by the ward surgeon, was that the man was suffering from psychoneurosis and acute nasopharyngitis.

From August 17 until August 23, 1943, he ran a low grade temperature and developed a frank follicular tonsillitis. A course of sulfadiazine treatment, consisting of a total of 3 grams, was given during this period. The lymphadenopathy and enlarged spleen did not change perceptibly.

At approximately 11:30 o'clock on the morning of August 23, while returning from the latrine in the ward, he felt a sudden, severe pain in the upper left abdominal quadrant, became very weak, and barely managed to get on his bed, when he collapsed. He was seen immediately by the ward surgeon, who found him pale, cold, and clammy; his pulse was slow but weak. The blood pressure was 70 systolic and 40 diastolic. Tenderness was noted in the left lumbar region and over the spleen. His condition was that of typical hemorrhage and shock.

The intravenous administration of blood plasma was started immediately and the foot of the bed was elevated. He was seen by the chief of the medical service in consultation, and we both felt that he was suffering from an intra-abdominal hemorrhage most likely coming from the spleen. Five hundred cubic centimeters of citrated blood was given him. During the following 2 or 3 hours his blood pressure rose to 100/80, and the signs and symptoms of acute shock subsided.

In the interim definite generalized tenderness developed over the abdomen, and we had the definite impression of shifting dullness in the abdomen on postural changes. The

total red blood cells and hemoglobin decreased and the white cell count increased. At first there was a polynuclearleukocytosis on differential count, but later we observed a definite reversal of the leucocyte lymphocyte ratio (Table I).

At 8:30 p.m. we decided to operate, but the patient refused. Operation was therefore delayed until we could reach his father and mother in Philadelphia and obtain their consent to operate.

Pentothal sodium was given the patient while he was in bed, and this was supplemented in the operating room by ether administered by the closed method.

Operation was started at 1:03 a.m. and ended at 1:44 a.m. August 24, 1943. An incision approximately 7 inches long was made over the middle of the upper left rectus muscle, extending from the costochondral angle to the level of the umbilicus. The abdomen was opened and a large quantity of dark blood was encountered. The spleen was found lying laterally against the abdominal wall. A large rent on its curved surface extended from the upper to the lower pole. It was delivered out of the abdomen and digital control was used on the pedicle until a series of clamps were applied. The pedicle was then divided and the spleen was removed. A mass ligature was placed around the pedicle, and each vessel was ligated separately distal to it. The raw surface was peritonized. Several double handfuls of clots were removed from the left trough in the region of the left kidney. The abdomen was then closed without drainage. During the operation 500 cubic centimeters of citrated blood was given. He returned to his bed in excellent condition.

Following is the pathological report (Figs. 1 and 2). The specimen consists of a spleen immersed in normal saline measuring 16 by 12 by 7 centimeters. On the diaphragmatic surface is a huge, gaping capsular rupture running the entire length of the spleen and measuring 8 centimeters across. This rent is covered by large shaggy clots. Cut section shows indistinct markings. It is impossible to identify the follicles. The pulp is bright, pinkish red. The capsule is thin, the consistency very soft.

Microscopic examination revealed the following. The follicles are enlarged and not sharply demarcated. The pulp is cellular with increase in the monocytic elements. The sinusoids are collapsed and contain little blood. The capsule is thin. A laminated thrombosis covers the torn splenic surface.

Diagnosis: ruptured acutely hyperplastic spleen.

The postoperative course was very stormy and hectic. On the day following operation he was given a third transfusion of 500 cubic centimeters of citrated blood. From this time his red cells and hemoglobin stayed normal or above. Two days following surgery his temperature arose to 107 degrees F. but was easily controlled by covering him with a wet sheet and allowing an electric fan to blow on him. X-ray pictures at this time showed evidence of pneumonia in the left base. Treatment with sulfadiazine, 1 gram every 4 hours, was instituted. His temperature became normal 5 days after the operation. The sulfadiazine was discontinued the next day. On the following day a typical sulfadiazine rash appeared which desquamated as time went on.

On September 4, 1943, the wound separated down to the deep fascia. A course of treatment consisting of vitamins B and C followed.

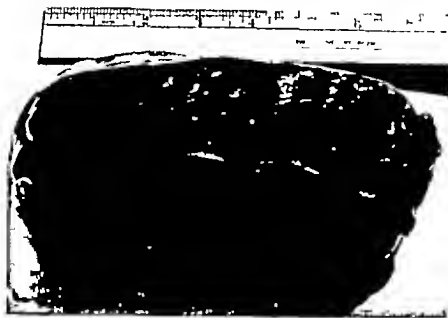


Fig. Diaphragmatic surface of spleen.

Throughout September 1941 there were episodes of low grade fever, anorexia, etc. Repeated examinations for undulant fever, malaria and the typhoid group were all negative.

During October he began eating better, gained eight and strength. He was transferred to the convalescent barracks. He began to complain of his earlier headaches and vague abdominal pains.

Finally, on December 9, 1941, he was given a certificate of disability discharge because of psychoneurosis, severe.

CASE 2. On November 5, 1941 an officer aged 24 years, entered the hospital, complaining of soreness in his upper left abdomen and weakness. Ten days before entering the hospital, after doing "tumbling act" in the gymnasium with other officers, he noticed severe pain in the upper left quadrant of the abdomen, which was followed by diarrhea. The soreness persisted but he was constipated for 4 days. Diarrhea occurred again followed by 3 days of constipation. The pain "feels like steady cramp," he said. By this time our staff had become "ruptured spleen" conscious. When the attending surgeon secured this history and found an enlarged tender spleen, he immediately admitted him to the hospital. On admission his blood count was 5,000,000 red blood cells, 4,200 white blood cells, polymorphonuclears 8 per cent, and lymphocytes 9 per cent. A transfusion of 500 cubic centimeters of citrated blood was given.

He was observed carefully during the next 36 hours. On this time in spite of the transfusion, his red blood cell count gradually fell. It was felt that the man was having slow intra abdominal hemorrhage probably splenic in origin. The chief of the medical service and I were very much interested in the reversal of the leucocyte lymphocyte ratio at this time (Table II).

After due consideration, operation was decided on, and was performed at 3:30 p.m. on November 20, 1941. Incision was made in the left paramedian line extending from the costophrenic angle to the level of the umbilicus, thus opening the abdomen. There was slight evidence of hemorrhage present. A self retaining retractor was placed in the wound. The anterior surface of the liver and gall bladder appeared normal. The abdominal contents were then gently pushed downward and to the right, exposing a very large spleen surrounded by free blood and blood clots. The dome of the spleen was found adherent to the diaphragm. These adhesions were broken down by blunt finger dissection. They were caused by an organized clot between the spleen and diaphragm. There was small rent on the dome of the spleen, which was bleeding. After delivery of the spleen from the wound, blood was seen coming from the splenic vein in the hilus. Three clamps were applied to the pedicle and it was cut between the distal and proximal ligatures were placed on each end and the raw surface was pentonized. All blood clots were removed from the splenic fossa. The liver and sur-

TABLE I.—LEUCOCYTE LYMPHOCYTE REVERSAL IN CASE I

Date	Time	Rbc	Wbc	Plasma	Pct	Lymphs
8-8-41		4,500,000	10,800			70
8-13-41	9:00 AM	4,700,000	8,700			87
8-13-41	10 PM	Transfusion 500 cc citrated blood				
		5,000,000	100			
8-13-41	10 PM	5,000,000	100			79
8-14-41	5 AM	Operation begun				
	11 AM	Operation ended				
8-14-41	3:00 PM	1,000,000	8,300			66
8-14-41	4:00 PM	Citrated blood				
8-14-41		3,000,000	11,300			89
8-14-41		4,000,000	1,000			8
8-14-41		4,000,000	8,000			70

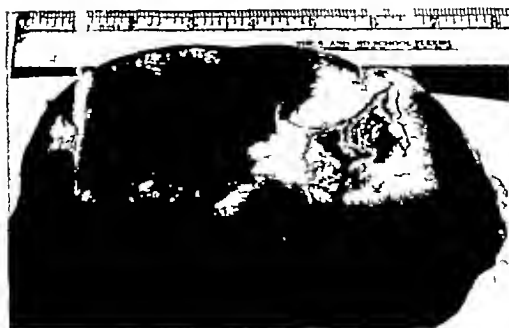


Fig. 3. Hilus of spleen.

rounding viscera were carefully examined for bleeding points, but none was found. The abdomen was closed and the patient was sent back to bed in excellent condition. Five hundred cubic centimeters of citrated blood was given during the operation.

Pathological report. The specimen consisted of a spleen immersed in formalin measuring 18 by 11 by 8 centimeters. On the diaphragmatic surface near the upper pole a 30 by 8 millimeter firmly adherent dark red clot was seen which extended into the splenic substance for a distance of 4 millimeters as a sharply defined red area. On the anterior margin nearer the lower pole two adjacent nodular 15 by 3 millimeter subcapsular hemorrhages bulge slightly above the general level. On section they are sharply defined and dark bluish red. The splenic markings on cut section are indistinct and deep red.

Microscopic examination revealed the following: Two large subcapsular hemorrhages were present. At another site the capsule was ruptured with a fragment lifted away over the blood clot with bands of fibrin. The follicles were indistinct. Both follicles and pulp were cellular. No abnormal cells were found. The sinusoids were congested with blood.

Diagnosis ruptured hyperplastic spleen with hemorrhage.

We are not as sure about the pathological condition here as we were in the first case. There were both new blood and an organized clot about the spleen. The spleen was adherent to the diaphragm by an organized clot. The small tear seen in the capsule at operation and the bleeding from the splenic vein could have been more recent and due to handling. In view of the fact that no other hemorrhage was found and the patient's bleeding stopped following removal of the spleen we are at a loss for any other explanation.

There is also a vague history of trauma here whereas the other case was spontaneous on a basis of sepsis (6).

The postoperative course was stormy but not as bad as was the previous case. Wangersteen suction was used for 4 days.

On the tenth postoperative day a friction rub developed at the base of the left lung. This was followed by pleural effusion. Aspiration had to be done approximately 35 days postoperatively. Following this the lungs cleared rather rapidly (Figs. 3 and 4). He was granted a sick leave of 30 days, 3 months following the splenectomy. On his return his chest was negative and his blood picture was normal. He returned to full duty.

In the report of the Ninth Service Command for the week ending November 20, 1943 a case of spontaneous rupture of the spleen was recorded. We requested information from the hospital in which it occurred and received a complete case report. The following is a brief résumé of the case.

TABLE II.—LEUCOCYTE LYMPHOCYTE REVERSAL IN CASE 2

Date	Time	Rbc	Wbc	Hb-gm	Poly %	Lymphs %
2-44	Out patient	4,350,000	6,000	3	60	
3-44	Admitted to hospital	3,000,000	4,200		3	9
3-44	Given 500 cc citrated blood					
26-44	9 am	3,850,000	1,000		75	24
26-44	3 pm	3,700,000	10,000		75	
26-44	8 pm	3,900,000	4,000	3	35	64
26-44	Operation 33 pm — ended 11 pm. 27 Given 500 cc citrated blood					
27-44		3,850,000	6,000	1.5	45	55
28-44		4,800,000	6,000		65	12



Fig. 3. Roentgenogram showing pleural effusion in left base.

CASE 3. An officer aged years, was admitted to the hospital November 4, 1943, 1:00 p.m. He gave history of feeling below par for 3 weeks. The only specific complaint was that of malaise and constipation. He had noticed transient abdominal pain on November 3, 1943, but continued to work. At 7:00 p.m. on November 4, 1943, two hours before admission to the hospital, he vomited several times, and had severe abdominal cramps.

On physical examination he was pale, his breathing was rapid, pulse 84, and his blood pressure was systolic 90, diastolic 49. His heart tones were poor. He showed moderate abdominal distention, peristalsis could be heard, but no masses were palpable. There are no areas of localized tenderness.

X-ray picture of the chest as reported. His urine was normal and his blood count was: red blood cells, 3,650,000; white blood cells, 4,400; polymorphonuclears 84 per cent, and lymphocytes 6 per cent. He continued to grow weaker. At 10:00 p.m. on November 5, 1943, he was operated under spinal anesthesia. A very large, soft, friable spleen, 13 cm. in length, was removed. Two thousand cubic centimeters of blood and lots of clots were removed. During the operation and immediately following it, he received 1,000 cubic centimeters of plasma and 1,000 cubic centimeters of citrated blood. At end of operation his blood pressure was 100/50 and his pulse rate was 120.

The pathological report follows. Specimen consists of spleen which has been sectioned and partly crushed by being forced into a small bottle so that the external shape cannot be made out. The splenic tissue together weighs 470 grams. In some places the capsule is elevated by small blood clots. The splenic tissue is poorly fixed except just beneath the capsule where small malpighian bodies can be made out. They are widely separated. The splenic pulp in the center of the organ is extremely soft, at least partly due to autolysis. Microscopic examination reveals marked diffuse cellular overgrowth of the pulp which widely separates the malpighian bodies and apparently infiltrates them at their periphery in most instances. Throughout the pulp there are seen numerous channels which are lined by endothelium. There is no evidence of increased connective tissue. In the pulp there are seen few plasma cells and rarely other mature leucocytes. The predominating cell is a fairly large mononuclear cell with deeply stain-



Fig. 4. Increased thickness in left diaphragmatic area after removal and absorption of pleural effusion.

ing nucleus and in most instances a relatively small amount of cytoplasm. Some of these cells have larger amounts of cytoplasm and distinct cell outlines. There are frequent mitotic figures and many of the immature cells show fairly prominent nucleoli. Reticulum stains of the spleen show slight variation in the amount of reticulum in different portions of the spleen, however there is no great increase and it is questionable whether there is any increase in reticulum. A relatively small number of the cells are surrounded by reticulum.

Interpretation: reticulum cell sarcoma of spleen.

By November 7, 1943, he had developed pneumonia in the left base and was placed in an oxygen tent. He was given sulfadiazine and other supportive treatment. Twelve days after operation after a severe coughing spell, the wound separated. This was closed under pentothal anesthesia. He never walked and died in spite of all supportive measures.

At autopsy the following findings are recorded: (1) pneumonia, lobes: lower lobe left, upper and lower lobes right; (2) pleurisy acute serofibrinous thickening, left severe secondary to lobar pneumonia, (3) embolism, or organized thrombus, right pulmonary artery severe probably secondary to lobar pneumonia (4) surgical absence of spleen.

SUMMARY AND CONCLUSIONS

1. Spontaneous ruptures (4) occur in the soft overdistended spleen of acute fevers, like malaria typhoid, typhus, acute septic splenitis and infectious mononucleosis. A rupture is said to be spontaneous (2) when it happens without apparent trauma or after the insignificant trauma of muscular exertion.

2. The 2 original cases of this report showed a reversal in the leucocyte-lymphocyte ratio before surgery which corrected itself soon after surgery.

(Tables I and II) In the last edition of *Physiological Bases of Medical Practice* by Best and Taylor the statement is made "The spleen serves three well recognized purposes namely (1) the final destruction of blood cells (2) the storage of blood and (3) the manufacture of lymphocytes in the lymphoid tissue composing the malpighian corpuscles. Immediately after operation there is usually a leucocytosis reaching as high as 30,000. At first the polymorphonuclears predominate but as the total count approaches normal there is usually a reversal and the lymphocytes predominate. Klemperer and Hirschfeld suggested that this action might be accounted for by removal of an organ where pressure, possibly hormonal, exercised a depressant action on the bone marrow. Bertell, Falta and Sweeger point out that the changes in the peripheral blood may also be brought about by the injection of substances which increase the tone of the autonomic or of the sympathetic nerves. Careful review of available literature did not reveal an instance of this reversal being recorded in a case of a bleeding ruptured spleen before its removal. In both of our cases repeated blood counts were made and the hemorrhage was sufficiently slow to permit this change before surgery.

3 Each of the 3 cases mentioned developed pleural and pulmonary complications. It started as pleurisy in the left base. In the second case pleurisy with effusion predominated. Since the

curved side of the spleen is against the diaphragm on the left side the irritation from the hemorrhage and from the trauma of the surgery causes a splinting of the diaphragm which invites stasis and localized atelectasis in the base of the left lung thus bringing about pneumonitis and pleurisy (Figs. 3 and 4).

4. Two of the patients had wound separation. In both of these the chest complications came on early with coughing. In the second case the chest complications manifested themselves after the wound had healed and the coughing did not disrupt the incision.

5 Embolism is a very common complication. It was probably the immediate cause of death in the third case report.

The splenic veins frequently become thrombosed. Since the splenic and the superior mesenteric veins unite to form the portal vein embolism may give rise to septic pyelophlebitis of the liver (5).

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ACCIDENTAL TRANSPLANTATION OF CANCER IN THE OPERATING ROOM

With a Case Report

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THE literature contains many references to local recurrence about the operative site, of cancer of the breast and of other organs. Ryall (3) nearly 40 years ago pointed out that recurrence was frequently due to contamination of the instruments used in operation with the cells from the tumor being removed. He cited a series of cases in which cancer of the breast, tongue, lip, larynx, rectum and colon were reimplanted at the operative sites through cancer infection of the wounds by contaminated knives and needles. He mentioned the post-operative occurrence of a distant nodule in the axillary fold following a radical mastectomy when a stab wound for drainage of the operative site was made with the knife which had been used in the mastectomy and concluded that it was therefore of the utmost importance to guard against the danger of implanting these cells into any fresh wound. In 1908 (4) he recommended a complete change of gloves, drapes, and instruments, and reparation of the operative site after biopsy of a malignant tumor has been completed and the exploratory incision closed. This recommendation has been made repeatedly since then, having been especially emphasized by Ewing in 1933 and by Saphir in 1936.

Saphir presented objective evidence of the presence of viable tumor cells on knives used for biopsies; he made smears directly from knife blades and from saline in which such blades had been rinsed. He found large numbers of tumor cells on blades used to incise tumor masses, and on those used to remove the tumors for biopsy prior to radical mastectomy. He demonstrated the viability of the cells by means of supravital staining according to the method described by Hickling. Thus, the presence on instruments of tumor cells, viable and capable of transmitting the cancer infection to other parts of the operative wound, which for many years had been assumed, was clearly demonstrated.

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Tumor growth is occasionally seen at the site of paracentesis or thoracentesis wounds in carcinoma of the peritoneum or pleura. We have seen this in 2 instances in the past 2 years.

The operators' gloves must obviously be another convenient means of transfer of tumor cells, and we wish to report here a case in which it seems evident that contamination of the gloves was responsible for transplantation of a highly malignant carcinoma of the breast from the mastectomy site to a skin donor area on the left thigh. We have seen no previous report of transfer to so distant a site.

CASE REPORT

Mrs. M W, 47 year old office receptionist, entered The Roosevelt Hospital on May 9, 1944, as patient of Dr. W C. White. Ten months previously she had noticed a small lump in her right breast, which had grown slowly. More recently her doctor had discovered axillary nodes.

Physical examination revealed a 5 centimeter nontender lump in the right breast, situated 1 1/2 clock, about 4 centimeters from the nipple. Its mobility was slightly limited, but it was not actually fixed to the impression of being attached to the underlying fatty tissue but not to the fascia. There was faint trace of dimpling of the skin over the tumor on movement. Three hard, nontender, freely movable lymph nodes could be felt in the right axilla, and smaller firm nodes were found in the left axilla and the right supraclavicular region.

On the second hospital day radical mastectomy was performed, with immediate skin grafting.

A radial incision was made over the tumor, high to gather the generous amount of surrounding fatty tissue as excised with the high frequency needle. The tumor itself was not incised. Frozen section revealed carcinoma. The biopsy wound was closed with silk and the patient was redraped, the operative area having been painted again with mercuric iodine. The operator, his assistants and the instrument nurses changed their gloves and gowns, and another set of instruments was substituted for those used in excising the tumor. A circular incision was then made about the tumor with the radius of about 1/2 inches, in order to avoid nicking or approaching the tumor site. The wound was extended obliquely downward toward the abdomen, after which the nipple skin, breast tissue, thoracic portion of the pectoralis major and the pectoralis minor and the axillary contents from the apex of the axilla, downward and out and out, were removed. The wound edges were sutured to the chest wall, leaving a large area, irregular in outline and measuring roughly 7 by 10 centimeters. A Padgett skin

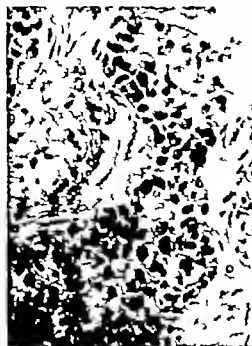


Fig. 1

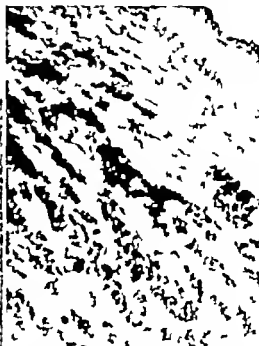


Fig. 2

Fig. 1. Primary growth in the breast. Grade III malignancy. Hematoxylin and eosin. $\times 288.6$

Fig. 2. Section of transplanted tumor nodule on left thigh. Skin surface visible at upper left. Hematoxylin and eosin. $\times 96$



Fig. 3



Fig. 4



Fig. 5

Fig. 3. Clump of tumor cells and lymphocytes found in sediment of washing fluid from operating room. Hematoxylin and eosin. $\times 322.6$

Fig. 4. Tumor cells in operating room fluid. Case of carcinoma of the breast. Tumor mass was not incised by the operator. Distilled water. Hematoxylin and eosin. $\times 322.6$

Fig. 5. Tumor cells in saline from operating room basins. Same case as in Fig. 4. Hematoxylin and eosin. $\times 322.6$

graft .008 inch in thickness, was then removed with a dermatome from a previously prepared donor site on the left thigh, and the graft was sutured to the wound edges with interrupted silk, punctured in many places, and dressed with a cellulose sponge for pressure. The donor area was dressed in a similar manner.

After the mastectomy and before the skin grafting was done, the operating and assistant gloves were washed in distilled water, but were not changed.

Pathological examination of the tissue showed a tumor mass measuring 3 by 3.5 centimeters, irregular in outline, unencapsulated, and extending into the surrounding fatty

tissue. Diagnosis was scirrhous carcinoma of the breast, grade III, with metastatic involvement of axillary lymph nodes (Fig. 1). Neither the tumor mass nor the involved nodes had been directly incised by the operator.

During a rather slow postoperative recovery, additional nodes were removed from the posterior triangle of the neck on the right side, and on examination these also revealed metastatic carcinoma. Epithelialization of the donor site on the thigh was slow, and the patient's general condition did not warrant discharge from the hospital until the 8th postoperative week. X-ray examination of the chest made just before discharge was negative.

One month later the patient was readmitted in stat of cachexia. X-ray studies at this time showed widespread metastatic involvement of lungs and bones, and there were local skin recurrences at the mastectomy site. Her course was rapidly downhill, and she died on the 32nd hospital day.

At autopsy the patient was pale, cachectic, weighing about 80 pounds. Multiple skin recurrences were noted along the mastectomy scar at the lines of incision and at the sites of suture wounds. Multiple metastases were seen throughout the chest cavity, particularly on the right, the right pleura, lung, pericardium and mediastinal nodes were involved, and there was a nodule on the wall of the right auricle.

The skin donor site on the left anterior thigh was studded with firm, discrete irregular nodules, the largest being about 0.5 centimeter in diameter (Fig. 2). Microscopic examination of these nodules revealed carcinoma similar to that seen in the primary breast tumor (Fig. 3).

The possibility of metastatic transfer by way of the blood or lymph stream from the breast to the skin of the thigh is too remote to be considered, and since no instruments were used both at the breast site and at the donor area, the gloves of the operator and his assistants must obviously have been the means of transfer of tumor cells. We have previously pointed out that the gloves were washed in the basins of distilled water provided in the operating room for that purpose after the mastectomy and before the removal of the dermato-tome graft from the thigh. Merely washing the gloves in this manner is obviously an insufficient precaution; the tumor cells may not be completely removed from the gloves, and in any event the washing fluid is contaminated with them. The gloves, still wet with this fluid, must thus be assumed to be contaminated.

We have centrifuged the contents of such basins, the fluid having a volume of $2\frac{1}{2}$ to 3 liters, and have found well preserved tumor cells in the sediment. It is not necessary that the tumor be handled deliberately. In 1 instance easily identifiable tumor cells were demonstrated in the fluid after a radical dissection of the right inguinal region for removal of tumor-bearing inguinal nodes (Fig. 3); the primary tumor a poorly differentiated squamous cell carcinoma had previously been removed from the dorsum of the foot between the toes. Since the nodes were not incised the contamination must have resulted from the opening of involved lymph channels, which obviously cannot be avoided. The accidental transfer of malignant tumor cells from an operative site to a distant part of the body can be avoided by changing gloves and avoiding the use of contaminated washing fluid after the tumor-bearing area has been handled.

Cells have also been found in a number of cases in the fluid used during operation for carcinoma

of the breast (Figs. 4 and 5). In cases in which the tumor has been handled directly and incised, the cells are more abundant as is to be expected. When distilled water was used it was necessary to centrifuge the fluid and make the smears rather soon after the washing in order to obtain well preserved cells. Cells left in distilled water for more than about 30 minutes before the fluid is centrifuged often become swollen and even disintegrated; such cells are probably nonviable. Even with distilled water, however, it should be possible to transfer viable cells when repeated washing of gloves is done at short intervals, when more than one operator uses the same basin, or when gloves are changed and the fluid used to wash the original gloves is again used to remove powder from the new pair before returning to the operation. When normal saline is used cells apparently remain viable for longer periods.

We have had no difficulty in verifying and repeating the work of Saphir. Tumor cells were demonstrated not only on the blades of knives used in resection or biopsy of malignant neoplasms, but on clamps and tenacula used to grasp breast tumors or to catch bleeding vessels adjacent to them.

SUMMARY

A case is reported in which, several months after a radical mastectomy for a highly malignant scirrhous carcinoma of the breast, cancer nodules were found in the skin of the donor site on the opposite thigh. The usual precautions had been taken after biopsy of the tumor and before the mastectomy, viz., changing of operators and nurses' gloves, and redraping and reoperation of the patient. However after the mastectomy when a defect in the skin over the operative site was to be covered a skin graft was taken from the left anterior thigh without first changing the contaminated gloves used at operation. Washing the gloves in sterile distilled water was apparently insufficient and tumor cells were transferred from the operative site to the raw donor area, where they survived and gave rise to tumor nodules.

Previous work in which tumor cells have been demonstrated on knives used for biopsies is reviewed and it is also shown that the fluid customarily used in the operating room to wash the gloves of the operators is another potential source of contamination of distant parts with malignant tissue.

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INTERCORPORAL BONE GRAFT IN SPINAL FUSION AFTER DISC REMOVAL

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FUSION of the adjacent vertebrae following the removal of degenerated discs is gradually being accepted as the proper procedure. In clinics where simple removal of the disc without fusion is performed the results are poorer than in those where the combined procedures are done. Due to this fact many more fusions are now being performed. Frequently patients who did not have fusions initially have returned for secondary fusions because of persistent low back pain long after the sciatic radiation had been relieved by removal of the degenerated and protruded disc. Other undesirable sequelae following disc removal without fusion have been illustrated in a recent paper by Graf and Hamby.

On both a theoretical and practical basis, fusion is indicated. Theoretically fusion should be performed because the low back pain which antedates the onset of radiating pain to the buttock or leg by months or years in the majority of cases indicates an instability in the lower spine. In addition, there are multiple anomalous developments of facets of the fifth lumbar vertebra and to a lesser degree the fourth. Their asymmetry and the fact that they are the last and most vulnerable movable segments attached to the pelvis indicate the desirability of fusion. These are the factors which seem to cause the high incidence of degeneration of intervertebral discs at these levels, eventually resulting in protrusion and pressure on nerve roots. We can recall many patients who were completely relieved of their symptoms by simple fusion done after a diagnosis of unstable fifth lumbar vertebra was made, with or without sciatic scoliosis. The latter we now know as a protective list. A review of the histories and physical findings in many of these patients reveals data identical with that of patients whom we now know to have sciatica from disc pressure. It can be assumed, since they were completely and permanently relieved without removal of the disc, that they could have had incompletely protruded discs or discs which caused nerve root pressure only in certain positions. At operation or in bed following the

fusion such discs probably returned to their normal positions and after fusion took place between the vertebral laminae were incarcerated in the disc space. Without intervertebral motion they could not protrude again.

It has been stated in some quarters that a fusion operation in itself is unnecessary, since thorough curettage of the disc space will allow the vertebral bodies to fuse. The proof for such a statement is lacking and vertebral fusion has been rarely demonstrated except in a few cases complicated by infection. The removal of the intervertebral disc and cartilage leaves a space between the vertebral bodies, the ideal situation for nonunion. The writer has had the opportunity to see several patients who came to fusion after discs had been removed elsewhere. In all of these cases motion between the adjacent vertebrae was readily demonstrated by pressure on the spinous processes at the time of operation.

This paper is a description of an adjunct to spinal fusion after disc removal.¹ A peg of bone is driven in between the vertebral bodies into the space from which the degenerated disc and cartilage plates have been removed. It is felt that this peg serves several useful functions: (1) It maintains the height of the disc space so that there will be no pinching of the nerve roots in the intervertebral foramina. Indeed in several cases in which the preoperative films revealed narrow disc spaces the postoperative films taken 6 weeks later revealed definite widening of the involved spaces. (2) The space left by removal of disc and cartilage is partially taken up by the peg so that there is no distraction and the space that would ordinarily be filled with blood clot and eventually fibrous tissue is partially taken up by an osteogenic bone graft. These factors tend to promote bony union between vertebral bodies. (3) The placing of the peg into the intervertebral space under forced flexion provides increased stability which allows earlier mobilization of the patient without fear of pseudarthrosis.

Operative procedure (Fig 1) With the patient lying prone and the lumbar spine flexed acutely

The idea for the use of the bone peg was the result of discussion with D. Henry Briggs of East Orange, New Jersey. It was under his supervision that the first bone peg was inserted in 1945, at the New Jersey Orthopaedic Hospital.

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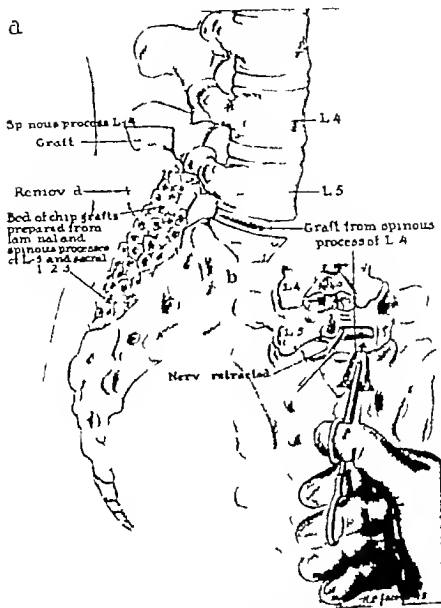


Fig. 1. a, The position of the posterior bone graft is shown. b, The manner in which the graft is inserted is demonstrated, diagrammatically (The nerve root is not retracted quite so vigorously in operation).

the lumbosacral spine is exposed subperiosteally through a midline incision from the third or fourth lumbar level to the level of the spinous process of the third sacral segment and laterally to the facets. A self retaining retractor is placed. For the exposure of the fifth lumbar disc the spinous processes of the fifth lumbar and the upper sacrum are removed flush with the lamina with an osteotome or heavy rongeur forceps. Ligamentum flavum and enough bone to permit the passage of a finger tip are removed from the

affected side of the interlaminar space to reveal the bulging or herniated disc pressing on the first sacral nerve root. If the disc appears normal and no nerve pressure is demonstrated the fourth lumbar disc is explored in similar fashion and the spinous process of the fourth lumbar vertebra removed. When the disc causing nerve root pressure is found, it is removed with a pituitary rongeur either through the hole in the annulus fibrosus through which it ruptured in the case of the herniated disc or through a hole cut in the



Fig. 2. The bone graft in position in the fifth lumbar disc space, 6 weeks postoperatively

annulus fibrosus in the cases of the bulging and hidden discs. The disc space is then thoroughly curetted to remove the remaining disc material and cartilage plates of the vertebral bodies. Care is taken to stay within the intervertebral space.

A rectangular peg is fashioned from the spinous process of the vertebra above. This is usually about 2 centimeters long and slightly higher than the estimated disc space. By levering on the adjacent lamina the former disc space is widened enough to allow this peg to be inserted into place. It is then rotated 90 degrees by means of a small curet so that the long axis is broadside to the hole in the annulus fibrosus through which it was placed. This diminishes the possibility of its being pushed back into the spinal canal. In the more recent cases, up to four pegs have been placed in the same disc space. The exposed nerve root which was retracted medially is allowed to return to its normal position and is covered with a piece of subcutaneous fat. Muscle or a thrombin coated absorbable starch sponge is used in troublesome hemorrhage.

A modified Hibbs or chip fusion is now performed. The facets are thoroughly curetted free



Fig. 3. The bone graft in position in the third lumbar disc space, 3 weeks postoperatively. The posterior fusion mass between the third and fourth lumbar vertebrae is well demonstrated. (In this case pantopaque myelography was performed because of bizarre neurological findings indicating that the lesion was not at the fifth or fourth lumbar disc. About two-thirds of the pantopaque was removed.)

of cartilage and bone chips are turned into the apophyseal joints. The laminae of the most superior vertebra to be fused are turned up cephalad in the form of a buttress. More bone chips are cut from the laminae of the caudal vertebrae with a gouge until no cortical bone is visible on the upper sacral and lumbar laminae to be fused. To these chips are added others cut from the previously removed spinous processes.

After wound closure the patient is placed in a firm bed without other support. He is allowed up in 3 to 6 weeks, usually with a light brace or canvas support. In recent months 2 patients have left the hospital without brace support, because they were unwilling to wear one. They have suffered no ill effects and follow up roentgenograms demonstrate satisfactory progression toward fusion.

Since the procedure described has been in use for only 2 years, no attempt is made to evaluate

THE INITIAL SURGICAL TREATMENT OF PENETRATING WOUNDS OF THE RECTUM

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THIS communication is based upon a series of 35 consecutive cases of penetrating wounds of the extraperitoneal portion of the rectum operated on at an Evacuation Hospital during the Italian campaign. Its purpose is to emphasize certain phases of the diagnosis, anatomy and surgical treatment of these wounds and to pose some questions relative to factors governing their management.

Missiles entering the body anywhere between the levels of the lower thigh and the costal margin have been known to penetrate the rectum. This is especially true of wounds of the dorsal surface of the body. Wounds of the buttocks, hip area, sacral area and posterior thighs are extremely common in warfare because of the prone position a soldier usually assumes while under fire. While wounds of these regions are most likely to involve the rectum, the incidence of rectal penetrations fortunately is relatively very low. In our experience, only 6 per cent of buttock wounds penetrated the rectum. Because of its protected anatomical location the rectum will usually escape injury unless the missile has crossed or has lodged near the midline.

The patient with a penetration of the extraperitoneal portion of the rectum may present no symptoms referable to this organ at the time of initial examination. Consequently, unless a thorough appraisal of the case is made prior to surgery the lesion may be overlooked. It is important to study the pathway of the missile by inquiring into the position of the patient at the time of injury and by careful examination. It hardly seems necessary to emphasize the warning that in studying roentgenograms one must make sure of right and left sides. Yet it is easy to assume that a foreign body lies on the same side as the wound of entrance, unless this point is checked. When roentgenological evidence indicates that a pelvic foreign body has traversed the midline, suspicion should be directed immediately toward the possibility of rectal injury. When no foreign body is demonstrable in the films, re-examination of the patient is imperative to ascertain the location of the wounds of entrance and exit, and to reconstruct the possible course of the missile. In one of our patients a shell fragment

had entered the body above the left iliac crest, perforated the rectum and emerged on the lateral aspect of the lower third of the right thigh. From the appearance of the wounds they seemed to be two completely unrelated penetrating wounds.

What often appears to be an innocuous wound of the buttock or thigh not infrequently is found to penetrate the rectum. The same warning has been made repeatedly in regard to wounds which penetrate the abdominal cavity via the buttocks and has resulted in routine abdominal examinations of patients with buttock wounds. However, in the event that the abdominal cavity does not appear to be penetrated, the possibility of rectal injury should not be overlooked before relegating the case to a low priority on the operative schedule during a rush period.

It is as important not to overlook concomitant injuries as it is to search for rectal injury. The urinary tract is investigated by physical examination for urinary extravasation by catheterization and by urinalysis. It has been our policy to carry out this procedure in every case of injury about the pelvis. The possibility of peritoneal penetration and major vascular injury is the object of careful routine examination.

On the other hand, the presence of other apparently more urgent wounds should not be allowed to divert the attention of the examiner away from the possibility of rectal injury. Wounds with dominating symptoms which are most likely to coexist with penetrations of the rectum and thereby lead to incomplete investigation of a rectal injury are: (1) penetrations of the peritoneal cavity from wounds in the groins, hip area, sacral area, buttocks or posterior thighs; (2) wounds involving the urinary bladder or urethra; (3) wounds involving the major vessels of the upper thighs and pelvis; (4) wounds involving the sciatic nerve; (5) wounds involving the spinal cord; (6) wounds resulting in compound fractures of the pelvis, sacrum or femur.

Gordon Watson relates a bizarre experience with a patient with a bullet wound of the greater trochanter. A wound of the rectum was not suspected 'until the patient passed wind through the greater trochanter with a high musical note.

When a breach in the rectal mucosa is repeatedly contaminated from intraluminal contents the spread of infection takes place along fascial planes.

The fascia of the pelvis is reflected over the muscular structures and over the pelvic viscera so that it is commonly resolved into (a) the fascial sheaths of the obturator internus muscle, the piriformis and the pelvic diaphragm (b) the fascia associated with the pelvic viscera known as the endopelvic part of the pelvic fascia or simply as the endopelvic fascia (2).

The endopelvic fascia is reflected over the various pelvic viscera to form fibrous coverings for them. It is attached to the diaphragmatic part of the pelvic fascia along the tendinous arch and has been subdivided in accordance with the viscera to which it is related. Thus, its anterior part, known as the vesical layer forms the anterior and lateral ligaments of the bladder. Its middle part crosses the floor of the pelvis between the rectum and seminal vesicles as the rectovesical layer. Its posterior portion passes around the rectum forming for it a loose sheath which is however firmly attached around the anal canal. This sheath is known as the rectal layer of the endopelvic fascia. By common usage the name "fascia propria" of the rectum has been applied to this part of the endopelvic fascia. Actually it does not belong to the mural structures of the rectum but, as has been pointed out, is part of the endopelvic fascia covering this organ.

The abdominal counterpart of the endopelvic fascia is the endoabdominal fascia (transversalis fascia) which encases the abdominal cavity on all sides. In fact, the endopelvic and endoabdominal fascias fuse at the upper border of the obturator internus muscle and have been described as one and the same layer. Analogous to the layer of fat containing blood vessels (propentoneal fat retroperitoneal fat) which lies deep to the endoabdominal fascia, is the pelvic layer of fat containing blood vessels, which lies deep to the endopelvic fascia. In the pelvis, where peritoneum does not exist this layer of fat lies directly upon the pelvic viscera serving as a protective layer for the blood vessels nourishing these organs. The portion of this fatty layer which surrounds the bladder is known as prevesical fat. The portion which surrounds the rectum is less well known but can be clearly demonstrated, especially in well nourished young adults and can be termed prerectal or perirectal fat. The only barrier between the perirectal fat and the lumen of the rectum consists of the coats of rectum itself namely the longitudinal and circular mus-

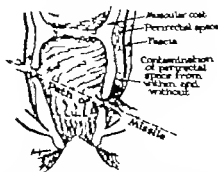


Fig. 3 Diagram of coronal section of rectum showing mode of contamination of perirectal space from within and without. Width of perirectal space exaggerated.

cular coats the areolar coat (tela submucosa) which connects the muscular and mucous layers closely together and the mucous membrane.

With this anatomical picture in mind the path of bacterial invasion from the rectal lumen via a wound in the rectal wall is evident. Bacterial contamination from an active fecal current can pass through the injured rectal wall and attack the susceptible fat (Fig. 3). Without an adequate opening in the rectal portion of the endopelvic fascia this layer of fat is placed under pressure and rapidly breaks down. Since most penetrating wounds of the rectum have long tracts from the point of entry on the skin to the lumen the various layers of muscle and fascia of the buttock, thigh or back whichever the case may be slide to form trap doors at each tissue plane. Thus the escape of infected material is blocked even in cases in which the missile tears a gaping hole in the rectal layer of the endopelvic fascia. This situation can result in either a localized pelvic abscess or in pelvic cellulitis. The latter condition is due to the continued breakdown of fat through out the pelvis under the pressure of infection which follows the path of least resistance. Because of the connection between the endopelvic and endoabdominal fascias, it is actually possible for infection to continue upward in the retroperitoneal fat to produce a perinephric abscess.

Infection of the perirectal space can occur even in the absence of penetration of the rectum when this space is not adequately decompressed surgically after a missile enters its confines. It was possible for us to study this type of lesion in a patient who had suffered multiple severe shell fragment wounds which penetrated the thighs, legs, feet back, and buttocks with several compound fractures including that of one femur. This patient died 6 days after injury following the development of clostridial myositis (*Clostridium oedematiens*) of the thigh. The missile which penetrated the buttock passed through the

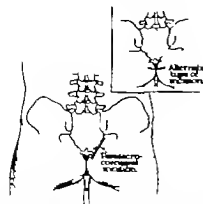


Fig. 4. Skin incision for parasacrococcygeal approach to incision of rectal portion of endopelvic fascia. Insert shows curved transverse incision below tip of coccyx as an alternate type of approach.

gluteal muscles and the sciatic notch penetrating the rectal portion of the endopelvic fascia, but spared the rectal wall. A sigmoid colostomy had been done because of confusion of the rectal mucosa, but the foreign body lying next to the rectum could not be removed nor could the perirectal space be decompressed because of the patient's desperate condition. The patient's postoperative condition never warranted a second operation to incise the perirectal fascia. This unfortunate situation afforded us, nevertheless, an opportunity to study the pathological consequences of contamination of the perirectal space from without uncomplicated by fecal contamination from within the rectal lumen as well as to observe the effects of inadequate decompression of the perirectal space. Postmortem examination of the tissue about the perirectal missile revealed a liquefaction necrosis of the perirectal fat extending for several centimeters around the missile which was a jagged piece of metal with a small piece of cloth. The rectal mucosa was intact and the missile plugged the tear in the fascia, thus allowing no escape for the enclosed space infection. Though this lesion was not responsible for the patient's death it could well have led to pelvic cellulitis or abscess formation. The routine administration of penicillin to this patient may have limited the spread of infection but only adequate surgical decompression of the perirectal space and removal of the foreign body could have allowed healing to take place.

The initial operative treatment of penetrating wounds of the rectum is designed to prevent this series of events by employment of the following procedures: (a) complete débridement of the tract; (b) adequate incision of the rectal portion of the endopelvic fascia (so called "fascia pro-

pria") with suture of the rectal wall when the defect is large; (c) construction of a temporary occlusive colostomy designed to divert completely the fecal current and to prevent recontamination of the wound from within. Some details of the technique employed in these procedures will be mentioned.

Removal of the coccyx does not, in itself, accomplish drainage of the perirectal space. Coccygectomy may or may not be a part of the operation, depending upon the individual case. Further, not only is coccygectomy unessential in most cases but it may actually contribute to certain postoperative complications.

In the early cases of our series we were performing coccygectomy almost routinely as a preliminary step to incision of the rectal portion of the endopelvic fascia. Surgeons in the base sector hospitals noticed instances of osteomyelitis of the sacrum and pain in the region of the coccygectomy in a few patients evacuated to them for secondary care (3). As far as we can determine, neither of these complications occurred in any of our cases. However, we agreed that not only could adequate drainage of the proper spaces be obtained without coccygectomy but that a longer incision could be made in the endopelvic fascia if the parasacrococcygeal incision was employed without coccygectomy (Fig. 4). Coccygectomy was reserved for those cases in which the foreign body actually fractured or partially destroyed the coccyx. When the sacrum was perforated the bony defect was débrided and the parasacrococcygeal incision made without coccygectomy.

In doing the parasacrococcygeal drainage, it is important to recognize the various anatomical layers as they are incised. After traversing the skin and subcutaneous fat the following layers can be recognized: superficial fascia, gluteus maximus muscle near its origin on the lateral aspects of the sacrum and coccyx, the thick, white fibers of the fused heavy ligaments (consisting of the superficial posterior sacrococcygeal ligament, the sacrotuberous ligament and the short posterior sacrolumbar ligament), loose areolar tissue, the relatively thin rectal portion of the endopelvic fascia.

With a finger in the rectum, the rectal portion of the endopelvic fascia is incised, thus exposing a thin fatty layer (perirectal fat). This fat may be blood stained and not easily recognizable but with careful dissection is unmistakable. In some instances the rectal finger may stretch the mural structures excessively, giving the surgeon the impression that the fascia must certainly have been

traversed because of the thinness of the tissues drawn over the finger. If the fatty layer is not identified the proper fascia has not been incised or the fatty layer has not been recognized. The incision in the rectal portion of the endopelvic fascia can be carried the entire length of the skin incision. Since the incision does not involve mural musculature of the rectum or anus, there is no reason to fear incision of the internal sphincter.

The incision described is done on the side of the penetration into the rectum. If there are two perforations it is done on the side having the larger defect. It need not be done on both sides. If the opening into the rectum is large and can be readily found it is closed with either interrupted sutures or a continuous suture of silk, bringing mucosa to mucosa. If the defect cannot readily be seen and proctoscopy has shown it to be small it need not be sutured since the contraction of the mural fibers in bowel at rest will permit the edges to meet and seal.

In the opinion of some surgeons, adequate drainage can be secured through a transverse curved incision inferior to the tip of the coccyx incision of the rectal portion of the endopelvic fascia and opening of the perirectal space by blunt dissection (Fig. 4). This technique was not employed in any of our cases.

When coccygectomy is indicated it is important to do a complete excision. To leave the proximal segment of the coccyx or a portion thereof usually results in pain on sitting as a late complication. Excision of the coccyx is done with a scalpel. As a rule no bone cutting instrument need be employed. The coccyx is disarticulated at the sacrococcygeal joint and the remaining cartilage on the articular surface of the sacrum is removed with a curette. If cartilage is allowed to remain it may become necrotic. Extensive partial sacrumectomy is probably an unnecessary procedure in most cases. If the wound has perforated the sacrum it is only necessary to remove contaminated and devitalized bone by curettement. If the posterior opening into the rectum is large and lies under the sacrum it can be sutured through the parasacrococcygeal incision without destroying a large portion of the sacrum for this purpose.

There is no need to discuss in detail the débridement of the soft tissue wound. Suffice it to say that this should be thorough with provision made for adequate drainage by generous incision of fascia.

The posterior portion of the operation (débridement and decompression) is best done before the

colostomy is made since it is preferable to complete the operation with the patient lying upon his back. It is well known that turning a patient toward the end of a time-consuming operation has a more profound effect on the patient's blood pressure than if he is turned early in the procedure. Furthermore, by doing the posterior portion of the operation first, it need not be rushed as it might be if done as a last minute procedure with the patient's blood pressure dropping. The only instance in which the abdominal portion of the operation is done first is in the case of active intra-abdominal hemorrhage.

The abdominal incision employed in cases requiring colostomy is usually a right paramedian incision. This incision allows somewhat more room for the occlusive dressings which separate the incision from the left iliac colostomy than would an incision on the left side of the midline.

It is not within the scope of this paper to describe the operative treatment of intra-abdominal penetrations, other than to state that a routine inspection of the intraperitoneal viscera is made and all visceral perforations closed including the perforation in the peritoneum caused by the missile, before the colostomy is made. It might be mentioned that perforations in the anterior intraperitoneal wall of the rectum usually bleed profusely and may be the only source of bleeding in a patient in severe shock due to intraperitoneal hemorrhage.

The usual site for the temporary colostomy in cases of rectal injury is the sigmoid colon. However, if any portion of the transverse or descending colon has been perforated by a concomitant injury, exteriorization of this portion of the bowel can be employed as the site for temporary colostomy. When the right colon or cecum is perforated as well as the rectum, it is advisable to perform a sigmoid colostomy in addition to whatever procedure is carried out on the right colon.

In instances of severe destruction of the rectum which will require extensive reconstruction at some future time, it is best to perform the colostomy in the transverse colon with the two stomata completely separated by a bridge of skin. The surgeon doing the reconstructive surgery will then be able to mobilize sigmoid colon downward, if necessary for the repair of the defect.

Our decision as to which type of sigmoid colostomy to perform—spur or loop—has been governed largely by the expressed preference of the surgeons in the base sector to whom our cases were evacuated. Some preferred to close the colostomies by crushing a long spur; others claimed it was easier to suture the loop colostomy.

and return it to the abdomen. In a recent comparative study it was found that the percentage of successful closures was about the same in both types. The problem thus resolves itself to one of individual preference of the surgeon doing the closure. Regardless of which type is done its main purpose is to divert the fecal current. It must place the rectum at rest by preventing any newly formed feces from being packed into the rectum. Stretching of the wall of the rectum can cause contamination of the perirectal tissues by the seepage of material through the wound in the wall.

The technique of enostomy will not be entered into in detail here since the salient features have been emphasized repeatedly in the literature. The usual precautions of mobilizing sufficient colon to permit a generous portion of exteriorized bowel to protrude without tension, were followed in our series. The left iliac muscle-splitting incision was placed as far lateralward as possible. When indicated, the lateral peritoneal gutter was obliterated by tacking the colon to the peritoneum.

Most of our colostomies were opened immediately after operation and a Paul tube placed into the proximal loop. This was removed after 24 hours. All loop colostomies were treated in this manner. In some instances of spur colostomy the bowel was clamped at the time of operation, and the proximal loop opened 24 hours after operation for the insertion of a catheter. In such cases the catheter was removed after an additional 24 hours, and the bowel was divided at the site of the clamp.

In no case was lavage of the distal loop carried out on the premise that whatever fecal material remained in the distal loop soon became dehydrated and stationary and might even serve as a "splint" around which the rectal wall could be immobilized, thus permitting healing to progress unimpeded. It is our impression that reinfection comes from new moist fecal material and from activity of the rectal wall rather than from inspissated, dehydrated contents.

Some mention should be made of the preoperative and postoperative care of these patients. All patients who were suspected of having an injury of the rectum were given the same operative priority as were patients with penetrating wounds of the abdomen; they were placed in the shock ward where they could get closer attention than in the preoperative wards during a large influx of patients. Here they were carefully examined and a record was made of temperature, pulse, respiratory rate and blood pressure. Patients with penetrating wounds of the rectum

were typed and their blood cross-matched for blood transfusion. If the patient was in good condition this procedure was nevertheless carried out so that blood would be available and ready at the time of operation. Patients in shock received an emergency transfusion of 500 cubic centimeters of low titer type O blood from our blood bank together with 200 cubic centimeters of a 2 per cent solution of sodium bicarbonate intravenously while their blood was being cross-matched for further transfusions. Most patients had received infusions of plasma at the battalion aid station or regimental aid station. Those in good condition were usually somewhat dehydrated on admission to our hospital. Such patients received an intravenous infusion of 1000 cubic centimeters of 5 per cent dextrose in normal physiological solution of sodium chloride, or in water slowly. Roentgenograms were taken after the systolic blood pressure stabilized over 100 millimeters of mercury. A urine specimen was obtained from each patient, by catheterization if necessary and an immediate urinalysis was done. Chemotherapy was instituted on admission of all patients. Early in our series, this consisted of administering 2.5 grams of sodium sulfadiazine dissolved in the intravenous solution preoperatively. Postoperatively 5 grams of sodium sulfadiazine was given daily in two divided doses 12 hours apart dissolved in the intravenous solutions until the patient could take the drug by mouth. He was then given 1 gram of sulfadiazine with 4 grams of sodium bicarbonate every 4 hours. Daily urinalyses were checked for sulfadiazine crystals, pH, and microscopic hematuria. Records were kept of fluid intake and output. Since May 1944, all patients received intramuscular injections of penicillin, 25,000 units every 3 hours, beginning on admission and continuing until the patients were well along in their postoperative course. A Levin tube was inserted into the stomach of patients suspected of having penetrating wounds of the abdomen.

Every patient operated on for a penetrating wound of the rectum received a blood transfusion during the operation, in amounts varying from 500 to 2000 cubic centimeters, depending on the requirements. Endotracheal gas-oxygen-ether anesthesia was used in all cases.

The postoperative management depended to a considerable extent upon the nature of the concomitant injuries. For example, those patients with penetrations of intraperitoneal viscera were treated with Wangenstein suction, intravenous therapy and parenteral vitamins for approximately 4 days. Those patients whose only vis-

eral wound was one of the rectum were allowed to have fluids by mouth beginning 24 hours after operation. Within 72 hours, their diet was usually converted to a dry diet to prevent a loose irritating stool at the colostomy.

The patients were kept at our hospital for a postoperative period ranging from 9 to 15 days, and were not evacuated to the base until they were in good condition.

ANALYSIS OF CASES

The interval between the time of wounding and the time of operation averaged 21 hours in our series, the extremes being 8 hours for the shortest time interval and 55 hours for the longest. Most of the long interval cases resulted from delay in evacuation in the mountainous terrain of the Casimo campaign in the winter of 1943-44. During this campaign most of the wounded had to undergo a dangerous time-consuming trip being first carried by shuttles of litter bearers down icy treacherous mountain trails often followed by a further trip by mule pack, and finally a long ride in an ambulance which had to pick its way along rough partially destroyed mountain roads. Although the terrain was even worse in the winter campaign of 1944-45 the casualties reached us in a shorter time because of ingenious improvements in methods of evacuation from the mountains, such as ski-litters and cable baskets. Once the patients reached our evacuation hospital the average time between admission and operation was $4\frac{1}{2}$ hours for our series of rectal injuries. Generally 2 hours was the minimal time necessary for resuscitation, examination, roentgenography and preoperative preparation.

The location of the wounds of entrance in our cases is worth noting. In 4 cases the wound of entrance was in the thigh. One of these had caused a compound fracture of the femur. In 3 cases the wound was in the hip area, and in one case it was above the iliac crest. These data lend importance to the warning that the rectum may be perforated in instances in which the wound of entrance is remote. In 9 cases the missile caused a compound fracture of the sacrum, coccyx or pelvic bones. Six of these entered through the sacrum. Eighteen wounds of the rectum were the result of wounds of the buttocks (Fig. 5).

In 21 instances, multiple wounds were present. Of these, 7 had penetrated intraperitoneal viscera, while in 2 patients the urinary bladder was perforated. Ten patients had concomitant wounds of extremities. Of these 2 involved major vessels, 1 the sciatic nerve, and there were 5 compound fractures of the extremities. Two patients had

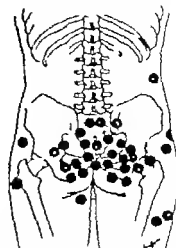


Fig. 5 Diagram showing location of wounds of entry of missiles which penetrated or perforated the rectum in series of 35 consecutive cases. This emphasizes the fact that wounds of entry may be remote.

thoracoabdominal wounds. It is these cases of multiple injuries which tax the endurance of the surgeon and which require painstaking clinical evaluation before surgery as well as diligent after-care.

Postoperative complications occurred in 5 cases. In 2 instances secondary hemorrhage from the middle sacral artery occurred, one 6 days after operation and one 8 days after operation. Both of these patients had had coccygectomies. The hemorrhage was arrested in both cases and blood volume was restored. Both had uneventful courses thereafter up to the time of evacuation 15 and 14 days postoperatively respectively.

In the other 3 cases, the complications led to death of the patient, although in only 1 case did the complications result from the rectal wound. These 3 cases constitute the total mortality in our series of rectal wounds, and represent 8.5 per cent of the series. In 1 case abstracted previously in this paper the rectum was contused but not penetrated although the missile entered the perirectal space. As stated this patient died as a result of clostridial myositis of the thigh muscles following severe penetrating wounds of this part and a compound fracture of the femur.

In the second case death was due to extensive damage to the parenchyma of both lungs and severe shock. The patient suffered multiple wounds of the back, one of which perforated the sacrum and penetrated the rectum. In the right chest there were comminuted fractures of the 7th and 8th ribs with laceration of the pleura, penetration of the right lower lobe with extensive interstitial hemorrhage and hemothorax. The missile which entered the left chest caused com-

minuted fractures of the 10th and 11th ribs, laceration of the pleura, hemothorax, severe interstitial hemorrhage of the left lower lobe, perforation of the diaphragm and laceration of the spleen. Besides these wounds, there were multiple penetrating wounds of the legs, arms, neck, and scalp, and a compound comminuted fracture of one foot. The right kidney was contused and there were cortical hemorrhages in both suprarenal glands. The patient was admitted 6 hours after injury in profound shock. Desperate efforts were made to treat the shock, but response was poor. Operation was undertaken on the basis of continued intra-abdominal hemorrhage. Through a laparotomy incision a splenectomy was done and a large tear in the left diaphragm was sutured. A sigmoid colostomy was brought out through a left iliac muscle-splitting incision. The penetrating wounds of the chest were debrided and the deep layer was closed. Thoracostomies were done, and all wounds were debrided. The perirectal space was drained. Although the patient rallied immediately after operation he never did fully recover from the state of shock, and died on the first postoperative day. In this case the rectal injury was of secondary importance and can hardly be implicated as a cause of death.

The third case illustrates the spread of infection along the anatomical planes described earlier in this paper. The patient reached our hospital 38 hours after injury during the *Casino campaign*. He was in severe shock, but responded to the usual treatment of massive blood transfusions and supportive measures. He had multiple wounds of the buttock, thigh and leg with evidence of a gas-producing clostridial infection of the thigh wound. There were two perforations of the extraperitoneal portion of the rectum; the patient's abdomen was rigid, and there were diminished peristaltic sounds. At laparotomy no visceral perforations were seen but about 2 ounces of turbid fluid was found in the lower peritoneal cavity. A small area of necrosis was noted on the anterolateral portion of the rectum at the peritoneal reflection. Gas was discernible in the retroperitoneal region over the left iliopectus muscle. Definite crepitus was noted with digital pressure on the posterior peritoneum in this region. A sigmoid colostomy was made. Colecystectomy with drainage of the perirectal space was done and the wounds of the extremities were debrided radically. There was no major vascular damage in the thigh but the muscle damage was extensive and showed signs of clostridial myositis. Despite all efforts, including antitoxins, penicillin and blood transfusions, the patient de-

veloped a severe toxemia and died 4 days after operation.

At postmortem the diagnosis of a clostridial gas-producing infection of the thigh was confirmed. Regarding the rectal lesion and the gas in the retroperitoneal space, the following excerpt from the autopsy protocol¹ is of interest.

On the anterolateral aspect of the lowermost portion of the intraperitoneal rectum at the peritoneal reflection is an irregular, patchy gray area of necrosis measuring 7 by 4 centimeters. This is on the right side. Dissection of the perirectal tissues reveals two tracts passing from the left obturator canal into the substance of the rectal wall here they perforate the mucosa of the rectum 6 centimeters apart, the highest at the level of the peritoneal reflection. These perforations are on the posterolateral aspect of the rectum on the right. The margins of the mucosal openings are ragged and gray and no foreign body can be located in the rectum or rectal wall. The pararectal tissues along the tracts and the perirectal fat at a distance from them exhibit a grayish green gelatinous edema and necrosis with no localization of purulent material. This edema extends to the brim of the pelvis posteriorly, but there is no evidence of gas-producing infection here. It is likely in view of the findings in the perirectal tissues that the gas encountered in this region was derived from the lacerations in the rectal wall, and not from the infection in the thigh, since there is no direct connection between the two areas of infection.

In this case the spread of infection under the endopelvic fascia had already taken place before the patient came to surgery. Whether the posterior decompression and colostomy ordinarily preventive measures, might have been successful as therapeutic measures in the presence of an already established infection, had the gas infection of the thigh not caused the patient's death, remains an unanswered question. This case illustrates the consequences of a long time lag before surgery in certain instances. However there were several other cases in our series with even longer time lags in which recovery followed initial surgery. This was the only instance in the series in which a spreading pelvic infection was seen.

FOLLOW UP

Since patients with rectal injuries did not leave our hospital until they were in good condition, there was little reason to expect infection to occur at a subsequent date. However questionnaires were sent out to base sector hospitals asking for follow up information on those patients which the author could not visit at the base. Information was obtained in 21 of our 35 cases, giving us a representative cross section of the disposition of the cases.

The follow-up covered an average period of 67 days after the patients left our hospital. Contact

Postmortem examinations were performed by Major Leo Kaplan, M.C. A.U.K.

was lost once the patients were sent to the zone of interior but all such patients were sent out in good condition. Of 21 patients on whom follow-up was possible there were no deaths. Colostomies were closed in the overseas theater in 13 instances. Of these patients 2 were returned to limited overseas duty while 11 were sent to the zone of interior. Some patients who might otherwise have had closure of colostomies overseas, were sent to the States without closure because of the severity of concomitant injuries or for reasons of general expediency. It is difficult, therefore, to estimate what percentage of patients with injuries of the rectum can be expected to return to limited overseas duty. Since there were no complications in any of the cases in which follow up was possible and since those who were sent to the States left the overseas base sector in good condition we can also feel justified in expecting a satisfactory recovery as far as the rectal injury is concerned, in most patients whose colostomies were not closed overseas.

DISCUSSION

The notable absence of complications due to infection in the follow up period of our series, and the almost complete absence of pelvic cellulitis (except in one case, in which this was present before surgery) bring up several questions pertinent to the initial surgical management in cases of rectal wounds. How many of these patients would have developed complications if the surgery had been less radical? Was colostomy necessary in every case? What about those cases in which posterior decompression was obviously inadequate, and which nevertheless had an uneventful course? What rôle did chemotherapy play in the outcome of these cases? What was the course of those patients in whom a rectal injury was not discovered?

Certainly the answers to these questions cannot be found in an analysis of our limited series. Perhaps, at some future date, after reports are compiled from theaters of operation throughout the world, it will become possible to state criteria on which to base the selection of cases of rectal injury for radical initial surgery. However some parts of these questions can be clarified from our experience.

We have felt safer in attempting to decompress the perirectal space and in diverting the fecal stream at the initial operation since it was necessary to evacuate the patients to rearward areas after approximately 10 days. The patients passed through the hands of several surgeons at various institutions, and it was impossible for

the original surgeon to follow each case to its conclusion. It was, therefore in all probability a safer procedure to design the initial surgery to prevent exigencies which might otherwise arise. In civilian practice, many of our patients might have been carried along under close observation until it could be definitely determined whether or not a colostomy should be performed.

Those patients in whom posterior decompression was obviously inadequate, but who nevertheless had uneventful courses probably had drainage through the opening caused by the missile. Surgeons at the base sector hospitals have observed an occasional case of pelvic abscess developing late but this complication was rare, and as far as we can determine, did not occur in any of our cases.

The exact rôle of chemotherapy in cases of rectal injury is unknown. There has been no noticeable difference in the course of our patients treated with sulfonamides and those treated with penicillin, despite the fact that penicillin has no effect on bacteria of the colon group. It is our impression that the initial surgery was the main feature in the treatment, with chemotherapy serving as an adjunctive control of infection.

As to the course of patients in whom treatment was delayed or in which a rectal injury went undiscovered we have two opposite types of cases to cite. One had an extremely rapid spread of pelvic infection within 38 hours while the second developed no ill effects whatever up to 8 days following rectal injury. The first case already abstracted was one in which the patient developed an extensive pelvic and retroperitoneal infection within 38 hours after injury before surgery was undertaken. As stated this patient died from a toxemia and clostridial infection of a thigh wound so that clear cut evidence of the effects of the pelvic infection could not be appraised. It is known however that this type of case carries a high mortality rate. In the last war for example pelvic cellulitis from rectal wounds resulted in a fatal issue in 45 per cent of cases (4). For purposes of illustration this case represents the rapid spread of pelvic infection from a rectal wound despite the use of prophylactic penicillin therapy.

By contrast, is the case of a patient with a perforation of the rectum who reached our hospital 6 days following injury without surgical treatment. He was a German soldier who was admitted from a German *Feld Lazarett* during the overwhelming influx of prisoner patients shortly after the mass surrender of the enemy in northern Italy. His wound was a transversely perforating gunshot wound entering the left trochanteric area and

emerging in a similar area on the opposite side. The only treatment he had received in the 6 days since wounding was an occasional dose of a German sulfonamide. The patient stated that he had had a few bloody stools for one or two days following injury but bowel movements had been normal since then. There were no fractures or signs of vascular injury. Proctoscopic examination revealed a laceration about 1 centimeter long in the posterior portion of the rectal mucosa 5 centimeters from the anus. The wound contained a bit of clotted blood and the surrounding mucosa appeared normal. There was no evidence of perirectal abscess. The external wounds were clean and dry. Temperature, pulse, and respirations were normal. In view of the patient's excellent condition and the 6 day interval since wounding, it was decided that a conservative policy be followed. Hence no surgery was done by us and the patient was placed on penicillin therapy and watched. He was followed for a period of 3 days at our hospital during which time he had no elevation in temperature, nor was he particularly uncomfortable. He was evacuated as a litter patient in good condition to a rearward installation.

This case illustrates the fact that there are some cases of rectal injury in which major surgery is not necessary for the recovery of the patient. But what criteria can the surgeon rely upon to determine in which cases of rectal injury major surgery will be required and in which ones it will not? Plainly there are no such criteria available at the present time. This fact has been largely responsible for our policy of performing a colostomy and decompressing the perirectal space in all cases of wartime injuries of the rectum. The results of this surgical policy have been most encouraging and have brought about a remarkable reduction in both mortality and morbidity as compared with previous statistics. Until new criteria can be established for proper selection of cases for nonintervention we believe that we should rely upon these surgical measures as insurance factors in all wartime injuries of the rectum.

SUMMARY

Experiences and results in the initial surgical management of 35 consecutive cases of battle injuries of the extraperitoneal portion of the rectum are reviewed. Important aspects of the diagnosis of such cases are presented. Rectal injuries in wartime are usually associated with multiple injuries of other structures, and it is important that the rectal injury not be minimized or overshadowed by the presence of other apparently more serious wounds at the time of initial examination. The anatomical relationships of the endopelvic fascia are reviewed to emphasize the purposes and aims which initial surgery must accomplish in order to prevent pelvic infection. The two main features of the initial surgery are (1) decompression of the perirectal space by adequate incision of the rectal portion of the endopelvic fascia (so-called "fascia propria") and (2) colostomy to divert the fecal current until the wound is healed. The surgical technique is described. During a follow-up period averaging 67 days in 21 cases, there was a remarkable absence of complications from infection. Certain questions pertaining to the care of rectal injuries remain unanswered, such as the rôle of chemotherapy and the selection of cases for nonintervention. The policy which we have followed and which is, in our opinion, the safest under conditions of warfare consists of surgical intervention as described herein, supplemented by chemotherapy in all cases of penetrating wounds of the rectum.

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THE USE OF CURARE IN ANESTHESIA FOR THORACIC SURGERY

Preliminary Report

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MOST thoracic surgeons in this area agree that the optimum operating conditions for intrathoracic disease, and also the least physiological upset to the patient, are afforded by the so-called "apneic technique" of anesthesia the patient's lungs being intermittently inflated by gentle pressure on the breathing bag. However this procedure necessitates the use of potent anesthetic agents, all of which with the single exception of chloroform, are explosive, thus contraindicating the use of the cautery once the pleura is opened. Most anesthetists consider chloroform too toxic a drug to use over the long periods required for intrathoracic surgery.

Although spinal analgesia permits the use of the cautery inside the chest in cases of thoracic surgery few anesthesiologists have availed themselves of this method as a means of producing apnea. Therefore, in our opinion controlled respiration cannot be used satisfactorily in these cases.

When curare was first utilized as a relaxing agent in anesthesia for abdominal surgery it was claimed that its danger lay in its faculty of producing respiratory depression which might even proceed to apnea if unduly large doses were used. As a result of this statement, we conceived the idea of using this property of curare for the production of apnea during intrathoracic operations. If this proved practical nonexplosive nitrous oxide could be utilized as the anesthetic agent and the surgeon could use the cautery inside the chest.

To date this technique has been used on 11 patients undergoing intrathoracic operations in this hospital. The cautery has been used within the pleura in every case. It has proved easy to produce apnea and control breathing and no difficulty has been encountered in any case in persuading the patient to resume spontaneous respiration. The use of prostigmin for this purpose has not been found necessary. The patient's general condition during the operation and post-operative course has been excellent in all cases.

The only complications which could be even remotely attributed to curare are 3 instances of postoperative atelectasis. These may be attributed to the type of operation and the result of the medication.

TECHNIQUE

On the morning of operation, the patient is heavily medicated with a short acting barbiturate morphine and scopolamine, so that he will be brought to the operating room just sufficiently awake to move from bed to table. A nitrous oxide and oxygen mixture is administered by means of a face mask. If any difficulty is encountered in producing anesthesia smoothly enough sodium pentothal is injected intravenously to attain satisfactory anesthesia. (Pentothal is rarely necessary.) During induction particular notice is taken of the proportion of nitrous oxide and oxygen necessary to keep the patient in first plane anesthesia and well oxygenated. A pharyngeal airway is inserted and the anesthetist's ability to inflate the lungs by pressure on the breathing bag is tested. We consider it unwise to administer curare unless a perfectly free airway allowing inflation of the lungs exists. A quantity of curare¹ calculated to be sufficient to stop spontaneous respiration is then injected intravenously. No particular precautions about speed of injection are taken. This first administration usually amounts to 150 to 200 milligrams of curare. Complete apnea or at least profound respiratory depression usually follows in from 30 seconds to 2 minutes. The patient's lungs are then inflated by gentle intermittent pressure on the breathing bag. After approximately 5 minutes, when the maximum relaxation has been attained the mask is removed and an orotracheal tube with an inflatable cuff is inserted under direct vision. The profound muscular relaxation usually makes intubation an easy matter. This tube is connected to a canister of soda lime and a breathing bag; the delivery tube from the anesthesia apparatus is attached and anesthesia is continued the same concentration of nitrous oxide and oxygen being used which was previously found to keep the

¹Intocostrin (Squibb).

¹From the Subdivision of Anesthesia, Department of Surgery University of California Medical School, San Francisco.

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FEBRUARY 1946

REORGANIZATION OF THE SURGICAL PUBLISHING COMPANY OF CHICAGO

IN accordance with the terms of the will of Dr Franklin H. Martin all shares of stock of The Surgical Publishing Company of Chicago at his death became the property of the American College of Surgeons subject to a life interest in the company in favor of Mrs. Isabelle Hollister Martin, his widow. Following her death, the management of The Surgical Publishing Company of Chicago which publishes SURGERY GYNECOLOGY AND OBSTETRICS thus has become the responsibility solely of the American College of Surgeons.

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VENOUS THROMBOSIS AND PULMONARY EMBOLISM

SUDDEN death during convalescence has always been a most disturbing episode. Lay people have learned to dread it and doctors have long been depressed by this insidious and unexpected interference with the recovery of their patient. Massive pulmonary embolism from the leg veins is the most common source of this catastrophe. In the middle twenties reports from large clinics showed that three persons in each 1000 subjected to surgery would die during convalescence from this cause. Much was done to prevent these deaths and by careful attention to frequent change in posture and efforts directed to diminish stasis in the leg veins, the ratio of fatalities from embolism was reduced to approximately 1 in 800. All this did not take into account the prolonged convalescence brought about by thrombophlebitis with the post

phlebotic edema and subsequent leg ulcers so frequently seen in those who recovered

Various studies directed toward this problem by many minds finally have brought about certain facts that are important. The development of bland thrombi in the leg veins that come about with no warning has been a new line of thought in recent years. Homans of Boston and Ochsner of New Orleans have contributed much to this subject. The former has preferred the term 'bland thrombosis' and the latter that of 'phlebothrombosis'. These men have emphasized the importance of thrombosis that is noninflammatory and due to the lack of reaction in and about the vein. There is far greater chance of such a thrombus leaving the vein and being deposited in the lung. If small, this detached thrombus produces an infarct or if massive enough it may completely occlude the pulmonary artery producing death within a few minutes. This is a different type of thrombosis than occurs in thrombophlebitis. In this latter disturbance of the venous return there is an inflammatory reaction that produces the painful swollen extremity known as phlegmasia alba dolens. That infarct or fatal embolism is less common in this type of thrombosis is an established fact. This is doubtless due to the firm attachment of the clot to the wall of the vein present in this type of inflammatory thrombosis. We have found that phlebothrombosis will often and in a higher proportion of cases in certain climates become thrombophlebitis.

Efforts to prevent serious sequela from thrombosis of the leg veins have led us to seek methods to prevent the thrombosis in the first place and if thrombosis occurs to prevent death from massive embolism and now to diminish the convalescence of such a victim even though a fatal embolus might be unlikely.

Anticoagulant drugs administered first after the thrombosis had become established came

into vogue with the discovery and use of heparin. This method gave excellent results in many cases but due to the difficulties arising out of its use it is now more generally relied upon as the adjunct to other forms of treatment. This drug could hardly be used routinely as a preventative unless the newer intramuscular type of heparin in-oil proves to be innocuous, inexpensive and reliable. Dicumarol seems to be satisfactory in the hands of experts as a preventative of serious thrombosis and has the advantage of oral administration and a low cost. However it carries the absolute necessity for accurate laboratory control of the prothrombin level and if great care is not exerted the complications may outweigh its benefits. Serious hemorrhage that has proved fatal in some instances has occurred following its use. In all probability further study and research along the lines suggested by the effects of heparin and dicumarol will eventually bring about a safe and satisfactory use of these or similar acting drugs.

Over ten years ago Homans reported four instances of femoral vein interruption in patients who were having repeated infarcts from bland thrombosis. Due to the immensity of the problem in the Massachusetts General Hospital there has come about a gradual but steady trend toward femoral vein interruption as an answer to this question. To August 1, 1945, 861 patients in this institution have been subjected to femoral vein interruption. At first attempts were made to determine whether or not a thrombus existed by phlebography—now this method has been abandoned. Early we learned that the apparent sick leg might be misleading and that often the most dangerous thrombosis was lying dormant in the opposite, apparently normal side. Therefore we have gradually become convinced that bilateral interruption should be done. Much time, thought, and discussion

have entered into the subject regarding the site of interruption. Vena cava ligations have been carried out successfully by Linton in 14 instances. He is disturbed that two of these patients have developed postphlebitic edema with ulcer. Iliac interruptions have been sponsored by Homans who felt that this more serious undertaking was justifiable in order to get above the clot and because the collateral circulation was better at that level than it was after femoral vein interruption. Common femoral vein interruption has been done in a considerable number of our cases but we realize that the technical hazard is greater and that actually a serious acute edema can follow this procedure under certain circumstances. The majority of our patients have been subjected to interruption of the femoral vein distal to the profunda femoris. This permits an easy exposure of a segment of vein without branches to allow opening of the vein and the removal of thrombi proximally and distally by suction and final complete division of the vein.

In this series there has been no fatality as a result of the procedure. There have been surprisingly few instances of infection or lymphorrhea. Only one of the patients has developed a postphlebitic ulcer. The average hospital stay after femoral vein interruption has been about six days. Patients operated upon before leg swelling develops have no postoperative edema worthy of note. If the operation is undertaken after bland thrombosis has become inflammatory with pain and swelling then a period of postoperative edema occurs. This edema may last several months depending on the duration of the thrombophlebitis

before and after vein interruption. Approximately 6 per cent of the patients having had infarcts before operation will continue to have infarcts afterward. These may be serious enough to warrant the use of anticoagulant drugs. In one instance only was there a fatal embolism arising from the profunda femoris after superficial femoral vein interruption—this in a seventy-four year old man with widespread carcinoma arising from the stomach. He had evidence of thromboembolic disease on admission with immediate femoral vein interruption. His death occurred 8 days later.

This operation is so safe and so simple and if done on the normal vein produces so little swelling of the extremity that prophylactic vein interruptions are being done with greater frequency. Up to the date of this writing this procedure has been carried out in approximately 100 patients in our clinic. All of this group have been elderly patients who for reason of their acute disorders, would need a prolonged period of bed rest. Typical of these are the aged with fractures of the hip region.

Control experiments are being carried out on a group of patients between the ages of 40 and 65 with dicumarol after operation. The results of this study may show that fewer femoral vein interruptions may be necessary in certain types of patients. We feel at this time that older individuals may be more safely managed by prophylactic femoral vein occlusion. Fatal embolism is so much less likely under the age of forty that signs and symptoms can be relied upon to determine the need of thrombectomy and venous interruption in younger patients.

ARTHUR W. ALLEN

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

PERHAPS the most significant book that has emerged from the medical aspects of this war is Grinker and Spiegel's *Men Under Stress*. Not only is it an important book, but also an interesting one for it deals with a vital subject associated with war in an interesting personal way. The two authors have put themselves into this book with enthusiastic competence. This gives to its many pages the elements of unusual industry, personal knowledge, experiences gained from combat observation and from close contact with every feature of the aviator's job and the weapons he is trained to use. There is technical information about these things which is unusual in most medical contributions which have come out of this war.

The case reports are fine examples of clinical reporting. They are generally brief and to the point, centering about and presenting the clinical symptoms while illustrating the significant situations producing the psychiatric picture. They contain relevant material for explanation, interpretation, and therapy. There are 65 of these case histories, which is perhaps too many and make the authors seemingly overzealous to furnish proof of their ideas. The evidence is overweighted by this accumulation of data. This encourages repetition so that the book spins itself out to too great length.

Through the protocols of the soldiers with their neuroses and the discussions which follow the core of the authors' theory of the neuroses which is built around anxiety and the struggles of the ego and superego is nailed down.

The average reader will be so impressed with the mass of case material and the theories derived from them that he will have little doubt of their absolute validity. The critical reader on the other hand may be doubtful of the validity of any absolute statements about the human personality, especially when these statements concern the dislocation of the personality in the neuroses as substitutions of its pre-existing form.

In attempting to evaluate medical contributions which are written about this war it is well to keep in mind the essential and necessary weakness of all war books written during it. This is especially true of those dealing with the medical aspects of war for the atmosphere of war is not conducive to that critical restraint which is essential during peacetime writing on the same subject. A study of the very large number of papers on the war neuroses published during and after the first World War will

show the necessity for a critical examination of this book. The conclusions of its authors should not be regarded as final and absolute, despite their evident wish to have them so regarded.

There is little evidence of the necessarily tentative nature of our present day thinking on the subject covered by this book. A too ready acceptance of the meaning and interpretation of the war neuroses is not an advantage at the present time but, it seems inevitable if this book is taken as the final answer. Neither the sincerity nor the competence of the authors can be questioned. Their therapeutic planning, the execution of the plans and their successful management of individual cases are also not questioned. The total conception of the war neuroses, as brought out in this book, however cannot be accepted without a weighing of evidence and the critical analysis of the key implications of the personality structure of the aviator with war neurosis. If the authors' theories are accepted as fact, what is true for him is true for every man whether his neurosis be of war or civilian origin.

The authors' approach to the war neuroses is what may be called disguised Freudian. The psychoanalytic formulae are everywhere apparent, but seldom mentioned as such. This fact is disarming. The reader will find much to his surprise, that he has been reading about the war neuroses from the point of view of psychoanalysis. The adaptations of the Freudian concepts of personality structure, anxiety, regression, identification, childhood experiences, the pain-pleasure principle, infantile trauma and so forth, to the neuroses of war are slipped in without any warning to the reader. He will be disarmed further by the omission, in great part of the sexual implications in most of these and other concepts which are so deftly used to build up a body of Freudian doctrine which is nowhere acknowledged as such. Freud is not mentioned in the body of the book, nor in its preface. It is as though the authors planned it that way so as not to arouse opposition or prejudice against the theories that bear the burden of psychoanalytic thought. As understandable as this is in the broad scheme underlying this book, the innumeration of the Freudian view and the use of Freudian hypotheses demand critical scrutiny because apart from the descriptions and clinical reports this book gives a broadly conceived and convenient demonstration of the concepts of the Freudian psychology as the definitive and final interpretation of the war neuroses.

Prime importance is given to anxiety both as an affective state in itself and as an affective state with

demonstrable objective symptoms as well as various combinations of both. From all these conditions mental and emotional turmoil result. The articulate, descriptive ability is more evident in those instances in which objective symptomatic displays are less impressive. The authors use case histories to interpret and elucidate first, the eternal struggle between the ego and the superego second the regressive drives as necessary accompaniment of the neuroses and third, the enmeshing, constantly present anxiety. Anxiety works effectively chiefly through the autonomic system, plus the important rôle played by the endocrine structures as an adjunct source of symptoms.

It may well be that at the present time, there is no more adequate scheme of understanding the neuroses than the one used by the authors. It may well be that they believe their use of Freudian hypotheses as applied to such an array of cases is convincing proof of their validity. By continued use and repetition the authors theories assume the aspect of truth rather than remain a series of psychological hypotheses and speculations. Thus these in the conceptions of the authors become absolutes. There is scarcely a page in which the ego and the superego regression and anxiety are not mentioned. These concepts or working hypotheses become in the reader's mind established facts. They stand out, therefore as sharply fixed as those facts which are experimentally derived in physics or chemistry or any science which depends, for validity upon controlled experiments. But, despite repetition these concepts remain working hypotheses and are by no means facts. That this is not overemphasized may be illustrated by mentioning the many terms used to describe anxiety: the ego and the superego. In the title of this book, "stress" implies an almost physical quality which in the physical sciences can be measured weighed, and mathematically studied. By use of such terminology the authors seem to be striving to give their hypotheses factual qualities. Anxiety is described by such words as "free-flowing" "pressure" "blocking" "waving," and "free-floating." Such qualitative and quantitative expressions are in constant use, both in the clinical descriptions and in the pages which follow each case to interpret and explain the theories.

It should be noted again that the criticism of this book is not intended, primarily for the psychiatrically trained reader. It is written for those who are interested in finding out something about the war neuroses as a part of a general understanding of the neurotic personality which comes into the general experience of physicians whose interests lie chiefly in the field covered by *Surgery Gynecology and Obstetrics*. It should be made clear to the general reader that the conceptions of the neurotic mechanism, so insistently emphasized are not to be taken as verifiable, but rather as a working scheme for which the authors have a strong predilection. The reviewer is referring specifically to the dynamic

picture of the ego and superego mention of which is found on almost every page of this book. A critical examination of these Freudian concepts of the personality and of the theories of the neuroses built upon these concepts has no place in this review. As working hypotheses they have become the permanent possessions of present day psychiatry and their value cannot be overestimated. In this book, however the two systems and structures of the ego and superego act as beings and not as functions. They are endowed with capacities, qualities, and drives which are often specific and exclusive and leave with the reader the picture of a personality made up of two hostile gangs forever at odds with one another forever quarrelling for mastery with sly and cunningly devised plots and schemes providing an atmosphere reminiscent of the Kentucky or Tennessee mountain fends. In this embattled area, the writers find no place for the great instinctive contender—the id. Its omission is strange and it is not explained.

In the chapter on psychodynamics, the central item in the causation or in the strategy of the neuroses is anxiety. About the meaning and implication of this affective state there have been endless discussions and polemics. The key to the understanding of the neuroses is the understanding of anxiety. This understanding is not facilitated by limiting one's conception of anxiety to apprehension and to loss of some loved one or object nor by attaching its conscious reactions to the ego. Anxiety has to do with the totality of a human being. Such a fundamental thing, so tied up with the maintenance of the integrity of a being, cannot and should not be limited to only one part of the personality. Nor is it likely that anxiety has its roots in past experience nor does it necessarily depend on them. Anxiety seems rather, to be the affective response of a person to situations in which disintegration threatens. The integrity of the organism is at stake. Anxiety stimulates fear or even arouses it and thus the attachment to some specific object or objectives is facilitated. The term "free-flowing anxiety" and attached anxiety would seem to be a contradiction. It is a device used frequently by the authors to add a realistic touch to this and other emotional reactions by endowing them with physical qualities, such as flowing, damming up pressure, and so forth. There is little doubt of the usefulness of such devices, but one can wonder if the gain achieved in clarity is sufficient to neutralize the risk of fixing, in the reader's mind theoretic ideas of the distorted personality as established facts.

The readers of this book, and there should be a great many of them, will not all have knowledge of the methods of psychiatric interpretation. Lacking it, they may get impressions perhaps lasting ones, of a mechanical human being with devices for its actions in war and peace, for which no experimental proof has been obtained. It is for this reason that the reviewer has thought it necessary to point out some of the imperfections of the authors' thinking.

on these vital questions. The reader will be so interested and entertained by the case reporting and by the general story that he will fail to see anything out of the way with the planned dynamics of the men under stress. There is too much good in this book to warrant quibbling over what, to him, are unimportant matters.

Psychiatry has suffered in comparison with other branches of medicine from a tendency to a too ready acceptance of working hypotheses as facts. What appears to be aspects of the truth in personality structure are, in reality, simply outlines or frameworks to strengthen the explanation and interpretations. This leads a degree of smoothness and tangibility which is deceptive. For example, the clear picture from this book, of the ego and the superego in a chronic state of a fitful and a feuding, is a doubtfully accurate statement of what happens to a personality whose structure has been discordantly shocked by war experiences.

The average reader, and possibly the more technically trained one, will find the chief interest of this book to be in the treatment and handling of the war neurotic aviators rather than in the psychological interpretations of the thing that caused his military disability. He will lose interest in the question of anxiety, regression, the ego and the superego fights but will be concerned with what is being done for them therapeutically. The chapter on treatment and results is much more brief than its importance would seem to indicate. Thus at first sight, seems an error in value judgment. But this is only a superficial view because in the body of the book which is made up of protocols of individual cases the authors never lose sight of the treatment and the reasons for the many types of therapeutic efforts. One of the outstanding excellencies is the infiltration of the case reports with the treatment problems. Along with this there is discussion of the problems based upon the psychological schemata chosen by the authors. This includes the type of therapy used and the reasons for it in with the basic psychological schemes of the psychodynamics of the situation. As a result of this conception of clinical reporting the reader in each case report has the conviction that a therapy is in the process of being developed. There results a kind of completeness and wholeness as if the story were told from beginning to end.

The special chapter on treatment is therefore a summing up and the reader is prepared to accept what is written there because he has become pretty well acquainted with it before. This book deals almost exclusively with the aviation wing of the combatant forces and mostly in actual combat environment. Some material is from the convalescent hospital in this country where the authors are at present, in active service. The clinical material, therefore, includes the pilot, the crew, the ground forces and the rest of the personnel who comprise the working organization of a flying unit. This focuses the attention of the study on the activities of the members of the crew in combat photography

reconnaissance, flight formation, and so forth. The aviation wing of the forces is a very selective group from the standpoint of physical fitness, youthfulness, intelligence and technical training. The screening for aviation is much more meticulous than for the army as a whole. The possibility of physical defects, especially in the special sense organs is reduced to a minimum. The absence of certain phases of the neuroses among flyers as contrasted to the infantry can therefore be well understood. Flyers as a rule are better housed, fed, rested, and have better recreational facilities. All this adds up to the fact that they should be more amenable to effective treatment, though they more readily succumb to war traumas.

The mobility of the flying forces so important a factor in decreasing the number and seriousness of war neuroses in the ground forces is a constant and not an occasional factor. The stresses are, perhaps more violent, but their duration is more brief. Group organization is tighter, smaller and much more essential to the smooth working of a crew than it is in other arms of the services. All this means that on this material therapeutic efforts should be more effective than anywhere else in the services, even though there are necessarily few statistical confirmations.

No new types of treatment are described but there are novel and interesting modifications of methods used in the first World War. Narcosynthesis is far better organized and developed than was formerly possible. Hypnosis was used then and is in use now but is less effective, on the whole than pentothal sleep. Shock treatment, the most recent addition to the therapeutic measures in psychiatry has a very limited use in the flying forces. The authors are very right in discarding this method and their reasons for so doing are pertinent. They place their main emphasis on narcosynthesis and the somnolent state produced by intravenous pentothal. This represents an advance in procedure of great importance for this drug acts quickly and routinely with few bad aftereffects. Such a drug was not available in World War I and attempts at producing the same effect had to be made with cruder drugs such as earlier forms of the barbiturates, bromides and chloral hydrate. Ether and gas were also used for producing this somnolent state.

The use of dream material to obtain descriptions of experiences in an emotional state was regarded then, as now, as a valuable source of information about the individual soldier undergoing treatment. Group therapy not then called by such a good term was an automatic necessity owing to the large number of cases and the scarcity of trained psychotherapists. There is very little mention of these earlier efforts and no mention at all of the man who, without doubt, is responsible for the beginnings of the important place psychiatry has achieved in this war—Dr. Thomas Salmon.

It should be clear in the readers' minds how narcosynthesis works and what it attempts to accomplish.

It is well to repeat here that the authors regard the use of pentothal, not as a treatment, but as a means of acquiring repressed or forgotten material, which can then be joined to the ego function in an effective synthesis. Consciousness then becomes the final arbiter and can choose the proper and healthy utilization of the traumatic experiences as experiences. By so enabling the soldier to face himself, the original traumatic situation and its emotional consequences, psychotherapy plus narcosynthesis releases the energy by which he becomes an integrated personality. This is a sound and intelligent therapy and it does not matter much what descriptive terms are given to the mechanisms which are active in the process of synthetic build-up. This rough and skimpy sketch of the therapeutic purposes of narcosynthesis does not begin to consider the techniques that are necessary to accomplish this purpose. Careful psychiatric knowledge and experience are necessary. In this book, they are described with care and minuteness.

The authors give detailed consideration to the limitations of the military psychiatrist and point out, wisely, that his job is primarily a military one and defined by military needs. His main duty and responsibility is to return to active duty as many patients as he can, and to prevent the occurrence of a neurosis in as many combatants as is possible. If the military authorities are convinced of his good faith in these two essentials, his advice on the final disposition of cases is generally followed. In this respect, military psychiatry differs from its peacetime brother in the final therapeutic goal. To

change, revise and alter a disruptive environment is an important part of civil psychiatric effort. In war the psychiatrist cannot possibly affect the arrangement or qualities of combat or precombat areas. He should try to return his cured or neurotic to the traumatic environment that originally produced the neurosis. This war necessity cannot be too greatly stressed and in this book it is amply and emphatically pointed out.

Men Under Stress is a book which will take its place as a permanent contribution to the knowledge already accumulated of the neuroses in this and the first World War. In spite of its length and its hurried, breathless style in places, there is no question of its value and pertinence especially at the present time. Its appeal rests largely on the very human quality which the authors have put into their writing. It is the story of men under battle and war-borne stress. It is also the story of a small group of men, themselves in the atmosphere of conflict who give freely and generously of their training, experience, knowledge, and good faith, to help the infinitely larger group of men who have succumbed, temporarily or permanently to the forces in the stress and stresses of war. It is finally the story of conflict where the enemy is no longer the armed might of opposing armies but the unarmed might of the neuroses.

Eight years ago Freud wrote these words: "What is the source of the neuroses? What is the ultimate, its specific, underlying principle? After decades of analytic effort, this problem faces up as untouched as at the beginning." S. J. SCHWAB.

CORRESPONDENCE

SEGMENTAL RESECTION OF LESIONS OCCURRING IN THE LEFT HALF OF THE COLON WITH PRIMARY END-TO-END ASEPTIC ANASTOMOSIS—A Correction

IN the December 1945 issue of *SURGERY GYNECOLOGY AND OBSTETRICS*, volume 81, page 593 in the article entitled "Segmental Resection of Lesions Occurring in the Left Half of the

Colon with Primary End-to-End Aseptic Anastomosis: Report Based on Fifty Cases" by John M. Waugh and Monford D. Custer Jr., the authors erroneously stated that Gibbon and Hodge had reported the mortality after exteriorization operations on the colon as 99 per cent. The figure should have been 39 per cent (14 patients, 4 deaths) as stated in Table II in the article by Drs. Gibbon and Hodge.

February, 1946

International Abstract of Surgery

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ABSTRACTS OF CURRENT LITERATURE SURGERY OF THE HEAD AND NECK

HEAD

Campbell E. H., Jr. Compound Comminuted Skull Fractures Produced by Missiles. *Ann Surg* 1943 122 35

One hundred cases of compound, comminuted fractures of the skull produced by missiles are analyzed. More wounds were caused by shell fragments than by all other means. Inner table fractures were sometimes overlooked and occasionally led to serious complications. Tripod incisions often gave trouble. It is recommended that they be avoided when possible. Convulsions were uncommon in the first few weeks; their occurrence was sometimes an early manifestation of abscess formation. Subdural hematomas were present in but 2 cases. Nineteen patients developed superficial wound infections of varying degrees, while 23 developed deep-seated infections. These were manifested by abscess, meningitis, cerebral fungus, or some combinations thereof. There were 5 deaths, all of which occurred in the latter group.

Incomplete débridement was the largest single factor contributing to wound infection. In those cases in which all bone fragments had been removed, infection was uncommon and seldom deep, whereas if débridement had been incomplete or had not been performed at all, infection was common and usually deep. Bacteria cultured from these wounds were principally skin inhabitants of low virulence.

Treatment consisted in the evacuation of pus and removal of associated bone fragments and/or metallic foreign bodies, as well as of adjacent necrotic tissue and old blood. Abscess capsules were disturbed as little as possible. Sulfonamide therapy was employed as an adjuvant. Failures resulted only in those 5 cases in which for one reason or another this procedure was not carried out.

Experience, judgment, and skill, as well as proper neurosurgical armamentarium are prerequisites to good primary débridement. It is recommended therefore that patients with severe head wounds be evacuated as directly as possible to a hospital in which these are available, even though a few additional hours be required.

Following the submission of this article in April, 1944, the number of penetrating wounds of the skull treated in the Mediterranean theater of operations increased several fold. Figures based upon 974 cases from the Tunisian, Sicilian, and Italian campaigns show the incidence of deep infection to have been 12.2 per cent. During the past year in particular débridement has been carried out with more thoroughness. Penicillin therapy (25,000 units given intramuscularly every three hours) has been the routine procedure. As a result, the rate of deep infection has been further reduced.

JOHN E. KEEFEATRICK, M.D.

EYE

Bland, J. O. W. and Wilson, R. P.: Bacteriological and Clinical Observations on the Treatment of the Acute Ophthalmias of Egypt with Sulfonamides and Penicillin. *Brit. J. Ophth.*, 1945 24 339.

The authors describe their bacteriological and clinical observations on the treatment of the acute ophthalmias of Egypt with sulfonamides and penicillin. They point out that the acute ophthalmias of Egypt are caused by bacteria which are sulfonamide sensitive and that treatment with sulfonamides is simple, safe, and effective. Sulfonamides provide the solution (for Egypt and other oriental countries) not only for the treatment of affected patients but also for checking and eradicating yearly epidemics, because they reduce the period of discharge from 6 to 1 or 2 days and render cases noninfective 12 hours after administration of the drug.

For every 10 kgm. of bodyweight, 0.5 gm. of sulfonamide was given in 24 hours as two doses, a single dose corresponding to the usual 6-hour dose which yields a concentration of from 5 to 10 mgm. per 100 c.c. of blood. Because the dosage based on bodyweight is not always convenient or practical, and because most cases occur in children under 10 years of age, a dosage based on age is suggested: twice daily 3/4 tablet (3/8 gm. tablet) at from 0 to 3 months; 3/4 tablet at from 3 to 6 months; 1/2 tablet at from 6 to 12 months; 3/4 tablet at 1 year; 3/4 tablet

at 3 years 1 tablet at 6 years 2 tablets at 9 years and 3 1/2 tablets at 20 years.

The authors conclude as follows regarding the acute epidemic ophthalmia (Koch-Weeks and gonococcal) of Egypt

1 A single dose of sulfonamide reduces the bacteria in 4 hours and suppresses them in about 12 hours which cures a considerable proportion of gonococcal cases by a single dose except the more resistant Koch Weeks cases

2 Two doses of sulfathiazole or sulfadiazine in one day at an 8-hour interval will cure practically all cases except Koch Weeks cases

3 Two doses on successive days will cure all cases of gonococcal and Koch Weeks ophthalmia

4 A single intramuscular injection of penicillin reduces gonococci to nil in 3 or 4 hours however repeated doses are necessary at short intervals to ensure a cure because relapses may occur in from 10 to 12 hours after a single dose

5 As penicillin has no effect on Koch-Weeks cases it is unsuitable for treatment of acute Egyptian ophthalmia

JOSHUA ZUCKERMAN, M.D.

EAR

Machle, W: Effects of Gun Blasts on Hearing. *Arch Otolaryngol* 1945 4: 164.

The characteristics of the hearing loss following controlled exposure to gun blast are like those of deafness from sustained high noise levels. Acoustic injury and loss are common in gunnery instructors, artillerymen and others potentially serious partial deafness may be expected to occur in significant numbers of military personnel. With repeated equal exposures acoustic damage is cumulative apparently largely because recovery from the initial traumatic response is incomplete in the 24 hour intervals.

Partial recovery of hearing regularly occurs in the first few days after cessation of repeated daily exposures up to six or eight. The rate and the extent of the ultimate recovery from the losses following long periods of exposure need to be further defined. After months of exposure, recovery to pre-exposure levels of acuity is doubtful there was evidence of partial recovery in only 1 of 10 men studied.

Preliminary observations indicate that the obvious relationship between magnitude of exposure, measured by blast pressures and the resultant hearing loss cannot be narrowly defined because of great variability in the response of individual subjects as well as uncontrollable variables in the behavior of blast waves

NOAH D. FABRICANT, M.D.

Periman H. B.: Reaction of the Human Conduction Mechanism to Blast. *Laryngoscope*, 1945 55: 477

An experimental investigation of the effect of explosions on the human conducting mechanism was carried out on fresh temporal bones.

The stimulus used was the shock pulse from a .33-caliber blank cartridge fired from a starting pistol

held near the external auditory canal of the fresh preparation.

Protection to the ear is considered and illustrative records are presented.

JOHN F. DUNN, M.D.

Shilling, C. W.: Aero-Otitis Media and Loss of Auditory Acuity in Submarine Escape Training. *Arch Otolaryngol* 1945 41: 69.

Since 30 per cent of the men undergoing submarine escape training at the United States Submarine Base at New London, Connecticut have had aural difficulty leading to aero-otitis media and resultant loss of auditory acuity the author presents an analysis of the extent of the damage associated with this training and outlines possible preventive and therapeutic procedures.

He believes certain preliminary observations can be made and some opinions hazarded at this time

1 All ears showing severe damage, grades 3 and 4 have thus far been found to have flattening of the eustachian orifices due to lymphoid hyperplasia, and thus roentgen rays and radium should be of great benefit.

2 Aero-otitis media has been noted to be associated with a depressed prepressure audiometric curve

3 Under conditions of careful selection of the patients and proper administration of pressure, severe otopathological observations with associated losses of acuity need not be as common as they have been

4 Since this type of trauma leads to acute auditory damage repeated trauma may result in permanent auditory damage.

NOAH D. FABRICANT, M.D.

Barton, R. T.: The Influence of Pregnancy on Otolosclerosis. *N England J Med* 1945, 233: 431

The records of 133 otosclerotic women who had experienced one or more pregnancies were reviewed. Sixty four per cent were stated to have been made worse by at least one of their pregnancies. Over half of these experienced the onset of hearing loss immediately after parturition (during the lactation period), and 19 per cent 6 months or more after ward. Seventy per cent noted the hearing loss in the first pregnancy, 16 per cent in the second and the others from the second to the seventh pregnancies.

In 30 per cent of the cases the hearing loss was noted only during one pregnancy and unaffected by others.

The conclusion is made from the review that many otosclerotic patients are adversely affected by pregnancy but there is little uniformity in the time of onset of the impairment and no regularity in the effect of successive pregnancies.

No records of the hearing before and after pregnancy are presented in this article.

The literature is reviewed on the question of interruption of pregnancy. The author concludes that abortion is never justified because (1) the effect of pregnancy on otosclerosis is unpredictable (2) abor-

tion may not arrest the progression of the deafness, and (3) the disease does not endanger the life of the mother

JOHN R. LINDSAY M.D.

Allman C. H. Penicillin in Otolaryngology *J Am Med Ass* 1945 129 109

In a series of 5,640 cases of scarlet fever, 9 per cent of the patients developed otitis media. Typings of the organisms cultured from the throats were done on 300 of these patients and all showed *Streptococcus hemolyticus* type 17. These organisms were resistant to sulfadiazine in *in vitro* studies. Over 75 per cent of the patients with scarlet fever had received sulfadiazine prophylactically from a few days to two months prior to the development of the disease. About 10 per cent of the patients had received penicillin from the time of onset of the disease and in these the incidence of otitis media was reduced approximately one half.

All patients with otitis media received 10,000 Oxford units of penicillin by intramuscular injection every three hours from the onset of the condition until two days after all signs had subsided. Local treatment to the ear was limited to dry wiping or in some cases, hot saline irrigations. There were 33 cases (0.56%) requiring mastoidectomy. In these, the operative wound also was irrigated with penicillin solution through a soft rubber tube secured in the cavity which otherwise was closed. From 5 to 10 c.c. of a solution containing 500 units per cubic centimeter was instilled every four hours.

All of the patients recovered and there was not a single case of a chronic discharging ear. With the exception of 3 cases in which the lateral sinus was opened, recovery was complete within a period of seven days.

There were 2 cases of meningitis in patients who had not received penicillin. Mastoidectomies were done on both patients. They were given 100,000 units of penicillin intravenously the first twelve hours, 15,000 units intrathecally immediately, 10,000 units intramuscularly every 2 hours for 2 days and every 3 hours thereafter until recovery was complete. Four grams of sodium sulfadiazine every 6 hours for a period of 2 days was also given intravenously. Recovery was rapid.

Penicillin was used in the same way in 14 cases of nonscarlet fever mastoiditis, with equally good results.

The use of penicillin is given credit for the reduction of morbidity to a minimum in this large group of cases of otitis media and there were no deaths.

JOHN R. LINDSAY M.D.

Macbeth R. G.: A Series of 50 Cases of Acute and Subacute Mastoiditis Treated by Closure of the Wound and Perfusion with Penicillin *J Laryngol Otol* 1945 60 16.

A series of 50 cases of acute or subacute mastoiditis in which penicillin was used postoperatively by perfusion are presented by the author. Unusual care was taken to get as complete hemostasis as pos-

sible following which a fine rubber tube was inserted at the upper end of the wound and sewn into place. The wound was closed completely. Penicillin solution was then run into the wound until it oozed out of the incision line. The concentration varied from 250 to 500 units per cubic centimeter.

Dressings were not disturbed for 5 days. During this time at 6-hour intervals the wound was evacuated and then filled with the penicillin solution.

Of the 50 cases treated, 9 were failures from the standpoint of early healing but all eventually healed.

The predominant organism was the *Streptococcus hemolyticus*.

No severe complications resulted and the technique was carried out easily by the nursing staff.

JOHN F. DREW, M.D.

MOUTH

Thomas K. H.: Functional Disturbances following Fracture of the Mandibular Condyle and Their Treatment *Am J Orthodont* 1945 31 575

The causes, diagnosis, treatment and prevention of complications following the treatment of condylar fractures are described by the author. Five cases presenting major functional disturbances are reported. In order to obtain a clear picture of the condition present, recommendations are advanced regarding the use of various positions in x-ray examination.

The prevention of complications includes exact reduction by the open method and internal wiring, plating or skeletal fixation. In fractures with displacement, interosseous wiring gives excellent results. In fracture dislocation, skeletal fixation of the condyle to the temporal bone is recommended in addition to the wiring. The two methods may be replaced by the use of the Sherman plate. Two cases of fracture dislocation illustrating the two methods are presented.

NOAH D. FARRINGTON M.D.

NECK

Harrington S. W.: Pulsion Diverticulum of the Hypopharynx at the Pharyngoesophageal Junction *Surgery* 1945 18 66

In a series of 140 cases of pharyngoesophageal pulsion diverticulum, 107 of the patients were men and 33 were women. Their ages varied from 34 to 80 years, the average age being 57 years. In 80 per cent of the cases the symptoms were vague at onset and slowly progressive. In 20 per cent they were more rapid in progress. The duration of symptoms was from 1 to 25 years, the average duration before operation being about 5 years. Fifteen patients had marked obstruction of the esophagus and 3 had complete obstruction at the time of admission.

The earliest symptom usually is dysphagia. Later food and mucus are regurgitated. After the sac has become well developed its enlargement is more rapid than before because of the increased pressure from within caused by retention of food and secretions.

tions Progressive esophageal obstruction often occurs and the patient's loss of weight may be great.

When a large sac that extends into the mediastinum is filled with food it produces marked pressure on the adjacent intrathoracic organs and causes a distressing sensation of fullness in the thorax, which often is associated with dyspnea palpitation of the heart and a sense of suffocation. Severe cough and choking spells frequently occur. Many times patients lower their heads, as is customary in postural drainage, and then press on the side of the neck in order to empty the sac. In some instances food may enter the trachea and cause marked cyanosis.

Repeated aspiration of food into the bronchi may result in bronchitis or bronchiectasis. In this series of 140 cases, bronchitis was present in 9 cases, and bronchiectasis in 4. Associated hoarseness of the voice also occurs. This is caused by pressure or inflammation around the recurrent laryngeal nerve, which is often close to the neck of the sac. In this series of cases, hoarseness was present in 8 cases; the vocal cord was fixed in 3 cases.

After the sac has become definitely formed, the symptoms are definite and characteristic. The diagnosis usually can be made on the basis of the symptoms, but it should be proved by roentgenographic examination. In the earlier stages when the symptoms are vague, a definite clinical diagnosis may not be possible without an esophagoscopic or roentgenological examination. These methods are the most accurate in the establishment of a definite diagnosis and the author believes they should be employed in all cases in which there are persistent signs of dysphagia. The longer the diagnosis is delayed the greater is the risk of serious complications which may enhance the difficulties and may impair the results of surgical treatment.

Complete removal of the sac, including its neck, is generally accepted as the only effectual surgical procedure for pharyngoesophageal diverticulum. The technical difference in the two operative procedures advocated to accomplish this purpose is in treatment of the sac and the time of its removal. In the one-stage procedure the sac is removed at the primary operation. In the two-stage procedure a temporary diverticulectomy is performed and the sac is removed at a second operation seven to ten days later. The fundamental difference in these two procedures is that in the one-stage operation the fascial planes leading to the mediastinum are not walled off prior to removal of the diverticulum and in the two-stage operation the interval between the operations permits the formation of granulations which wall off the fascial planes of the neck and mediastinum. In this series of 140 cases, the one-stage operative procedure was performed in 113 cases and the two-stage procedure in 25 cases.

Patients who have lost considerable weight as a result of their inability to obtain sufficient nourishment require preoperative feeding. In most instances this can be accomplished by an indwelling stomach tube. Sixteen patients in this series of 140 cases

were prepared for operation by this means. In one case in which complete obstruction was present it was impossible to pass the stomach tube, and a preliminary gastrostomy was necessary for feeding.

Dilatation of the intralutal of the esophagus is advisable and has been performed routinely in the last 50 cases of this series. In many instances the intralutal is distorted and dilatation minimizes the danger of exerting pressure at the site of closure of the pharynx when the patient swallows food postoperatively.

In all cases in which there is any evidence of retention in the diverticulum, a roentgenological study of the thorax should be performed immediately before operation. The reason for this is it is certain that no barium has been retained in the diverticulum, which at operation might be aspirated into the lungs. In those cases in which retention exists, the diverticulum should be irrigated thoroughly to remove the contents.

The vocal cords should be checked both preoperatively and postoperatively. In any case in which the patient has symptoms of hoarseness it is advisable to check the vocal cords preoperatively.

A thread which is passed through the esophagus into the stomach the night before operation is left in place until the patient is taking nourishment satisfactorily after operation. This provides a guide over which a stomach tube can be passed if a postoperative pharyngeal fistula should develop. This, however, may be unnecessary since only one of the author's patients has required passage of a stomach tube postoperatively because of a pharyngeal fistula. Formerly the author left a stomach tube through the esophagus at the time of operation, but this practice was discontinued because the tube was often irritating to the esophagus and produced considerable mucus which may be detrimental to healing of the pharynx.

Operation should not be undertaken if the patient has had a recent infection of the throat or lungs, because of the danger associated not only with infection of the throat but also with cough postoperatively, both of which would interfere with the healing of the tissues.

The author prefers regional nerve block by the use of procaine. This method permits the patient's reflexes to remain active, which is a helpful safeguard in many instances. If an accumulation of secretions is present in the sac at operation, these secretions can be carefully emptied into the pharynx; they may be either aspirated by suction or swallowed. The act of swallowing is often helpful in identifying small diverticula, as air is forced into the sac. The surgeon also finds it helpful if the patient can talk during dissection around the neck of the sac posteriorly because of the close proximity of the recurrent laryngeal nerve. This is true particularly in those cases in which, because of considerable inflammatory reaction around the neck of the sac and in the surrounding tissues, visualization of the nerve is difficult.

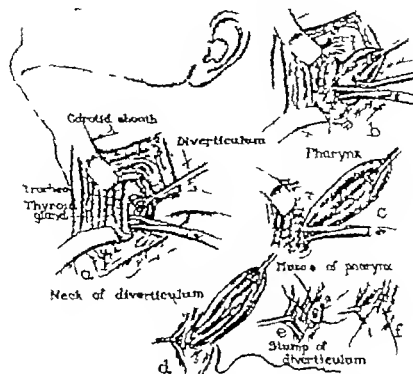


Fig 1. One-stage diverticulectomy. a, Incision along anterior border of sternocleidomastoid muscle, retracting the thyroid medially and the carotid sheath with the sternocleidomastoid muscle laterally. The peritracheal fascia is incised at the level of the cricoid cartilage, to expose the diverticulum. b, Dissecting the diverticulum from the peritracheal fascia and elevating it from the fascial planes, starting at the neck of the sac. c, Dissecting the true neck of the sac from the surrounding muscles of the posterior wall of the pharynx. d, Transfixing and ligating the neck of the sac with chromic catgut. e, Invagination of stump of sac into wall of pharynx. f, Closing the opening in the muscles of the posterior wall of the pharynx with chromic catgut.

The method of approach to the diverticulum depends on its location but it should be from the side of the neck on which the diverticulum is situated. If the diverticulum originates in the midline, the author prefers a left cervical incision. Diverticula usually occur on the left side but in many instances occur on the right side. In this series of 140 cases the approach was through the left cervical region in 126 cases and through the right cervical region in 24 cases. In one case an infected diverticulum was removed through the left cervical approach. The diverticulum subsequently recurred on the right side and the approach was through a right cervical incision.

The side of the neck from which to approach a diverticulum is determined by a careful study of the anteroposterior roentgenogram. In some instances in which determination of the exact position of the neck of the sac is difficult, esophagoscopy examination is of value.

In the one-stage procedure the incision is made through the skin and platysma myoides muscle and along the anterior border of the sternocleidomastoid muscle from the hyoid bone above to a point about 3 cm above the clavicle. The external jugular vein

is often in the line of incision. In these instances the vein is cut and ligated. The sternocleidomastoid muscle then is separated from the omohyoid and sternothyroid muscles. The latter are retracted medially. This exposes the carotid sheath which with the sternomastoid muscle, is retracted outward. The thyroid gland is exposed and retracted upward and medially. This exposes the peritracheal fascia which surrounds the trachea and esophagus. If appreciable hypertrophy of the thyroid gland is present, partial lobectomy may be necessary in order to obtain adequate exposure of the fascial coverings of the diverticulum. In many instances particularly if the diverticulum is approached from the right side the inferior thyroid artery and vein course over the diverticulum and in these cases the vessels should be cut and ligated. The fascia then is incised posterior to the trachea at about the level of the cricoid cartilage. The neck of the diverticulum usually is located readily at a point opposite the level of the cricoid cartilage.

Several methods such as the use of bougies and the esophagoscope, have been suggested for locating the diverticulum but the author has not found these methods necessary. There is never any difficulty in

locating the larger types of diverticula as they lie lateral or posterior to the esophagus. The small diverticula, which often are buried in the cervical fascia, can be located readily by the simple procedure of having the patient swallow or air may be forced into the diverticulum. The location of diverticula that occur through the posterolateral wall of the pharynx is greatly facilitated by approaching them from the side of the neck from which they originate. If a diverticulum originates from the right posterolateral wall of the pharynx and is approached from the left side, there may be considerable difficulty in locating it as well as in visualizing the neck of the sac.

After the diverticulum has been located the fascial coverings are carefully dissected away until the true wall of the sac is reached. The fundus of the sac is elevated into the wound and dissection of the neck of the sac is carried out as it appears through the muscular wall of the pharynx. Great care should be exercised to this dissection to avoid perforation of the sac or injury of the surrounding structures, particularly the recurrent laryngeal nerve. This nerve is often in close proximity to the neck of the sac, particularly in those cases in which the sacculation passes through or beneath the cricopharyngeus muscles. It is important not to separate the fascial planes more than necessary to remove the body of the sac, particularly when the diverticulum extends into the mediastinum.

After the sac has been completely dissected free from the surrounding structures the true neck of the sac is dissected from the pharyngeal muscles. Particular care is taken to separate and remove any fibers of the inferior constrictor muscle and of the cricopharyngeus muscle above and beneath the neck of the sac, respectively. In many of the larger diverticula, the opening into the pharynx is large and consists essentially of diffuse bulging of the back wall of the pharynx. In this type, great care should be exerted to determine the true relationship of the opening of the sac to the muscular wall of the pharynx which often is much thinned out. It is important to dissect these diffuse sacculations from the muscle and to establish as small a neck to the sac as possible, with care not to remove too much of the mucous membrane because of the danger of producing a stricture. After the true neck of the sacculation has been isolated from the surrounding muscles, it is transfixed by the use of chromic catgut and the diverticulum is completely excised. The stump of the sac is then invaginated into the wall of the pharynx and the muscles of the wall which surrounded the neck of the sac are closed with interrupted catgut sutures. The silk thread which is through the esophagus is pulled taut by the anesthetic before the neck of the sac is ligated so that there is no danger of including it in the closure of the neck of the sac. A soft rubber tissue drain is placed in the pocket formerly occupied by the diverticulum but it is not placed at the site of closure of the pharyngeal wall. The wound is closed by the use of interrupted sutures.

In the 115 cases in which the one-stage operation was performed, there were no operative deaths. A temporary pharyngeal fistula developed in 5 cases. In 3 cases hoarseness occurred in 2 to 3 days after operation and subsided within 1 week or 10 days. In one case in which the patient had hoarseness of the voice before operation paralysis of the cord occurred and the hoarseness continued. The average duration of convalescence in the hospital was less than 2 weeks and the average period of time to dismissal was 3 weeks.

In 5 cases angulation of the esophagus required dilatation. The diverticula recurred in 2 cases in one of these the symptoms improved after dilatation but operation subsequently may be required. In the other case, a second operation was necessary.

The author believes there is little risk of mediastinitis after a one-stage operative procedure because in none of his cases has a fistula developed before 72 hours after operation. By that time the mediastinal fascial planes are well off. However it is important not to separate any more of the tissues of the mediastinal fascial planes than is essential, and to remove the diverticulum starting at the neck of the sac.

Fifteen of the 115 patients in this series had large diverticula that filled the entire mediastinum. In several instances they extended into the thoracic cavity. The largest one held 825 c.c. of fluid. There was no suggestion of mediastinal infection after operation in any of these cases.

The results of operation in the 25 cases in which a two-stage operation was performed were as follows. There was 1 operative death in the case of a patient who had Parkinson's disease. Although this death was attributed to the operation, it was the result of his poor general condition; the latter was caused by weight loss as a result of his inability to take nourishment because of the diverticulum as well as advanced Parkinson's disease. A temporary fistula developed in 6 cases. In 3 cases there was temporary hoarseness and in 1 case there was paralysis of one vocal cord. The average convalescence before dismissal from the hospital was more than 5 weeks.

Five patients had angulations that required subsequent dilatations. There were 3 recurrences, all of which were treated by dilatation. Two patients subsequently may require surgery.

Neel, H. B., and Pemberton, J. D.: Lateral Cervical (Branchial) Cysts and Fistulae. *Surgery* 945
8 857

Congenital cysts and fistulas which appear on the lateral aspects of the neck are referred to as branchial, ventral, and lateral cervical. There is no unanimity of opinion as to the etiology of these lesions. The work and theory of Wengowski, however, have greatly influenced thought on this subject.

Several members of the same family and of one or more generations may be afflicted. Other congenital lesions also are encountered occasionally in patients with lateral cervical cysts and fistulas.

Involved the accessory sinuses the roentgenographic examination frequently showed much more extensive involvement than was suspected from the clinical findings. In several instances a tumor that appeared clinically to involve only the maxillary sinus and nasal fossa was found by roentgenographic examination to be present in the ethmoid cells and frontal sinus as well. In this group, too malignant destruction of the floor and walls of the maxillary sinus, ethmoid cells, orbit, nose, and zygoma was evident at times. In one case in which a nonulcerated tumor protruded from the vault of the nasopharynx, roentgenograms showed extensive destruction of the sella turcica and cloudiness of the sphenoid sinus which revealed that either of these regions was the site of origin of the neoplasm. Roentgenograms of the thorax were normal in all of the patients at the original examination at the clinic.

Only in one of the 11 cases was metastatic involvement of bone demonstrable roentgenographically at the time of the primary examination at the clinic.

This was a case of a huge, rapidly recurring tumor of the upper jaw, maxillary sinus, ethmoid cells, and nasal fossa. Roentgenographic examination of the maxillary sinus disclosed not only extensive destruction of the upper jaw, maxillary sinus, and ethmoid cells but what appeared to be multiple areas of metastatic destruction throughout the skull as well. The patient had no symptoms referable to the secondary tumors. The metastatic involvement might well have furnished a clue to the nature of the lesion had the patient been observed prior to partial removal of the neoplasm of the superior maxilla and cheek. The trauma attendant on this therapy had produced extensive sloughing and inflammatory reaction so that the condition strongly suggested a fulminating type of squamous-cell carcinoma. Although the tumor of the upper jaw and maxillary sinus had been noticed by the patient for only three months it was assumed that the malignant process was primary in this situation and that the smaller deposits observed throughout the calvarium were secondary.

SURGERY OF THE NERVOUS SYSTEM

PERIPHERAL NERVES

White, J. C.: Pain following Injuries of the Peripheral Nerves. *U S Nav Med Bull.*, 1945 45 845

The problems outlined in this article have occurred innumerable times during the present conflict, and neurosurgeons and neurologists have had ample opportunity to study and evaluate them. Yet there is still no complete unity of opinion with regard to the underlying mechanisms. Painful stimuli may be due to faulty regeneration, sepsis and scar tissue formation, although anoxia plays an important role. Anoxia may be due to local scarring or widespread vasoconstriction. Vasoconstriction is particularly liable to play a part in emotionally unstable persons with vasospasm. Direct cross stimulation of sensory nerve fibers by afferent sympathetic impulses is a theory which deserves careful consideration. There are two types of intractable pain commonly associated with peripheral nerve injuries: the phantom limb pain and the causalgic pain. The phantom limb pain often shows psychic manifestations in that it may come and go with the patient's frustrations and achievements.

The treatment of pain in peripheral nerve injuries is satisfactory and more or less straightforward, and it is clearly shown that certain outmoded methods are to be avoided. These methods include reamputation, chemical blocking of nerve trunks at gradually ascending levels, repeated resection of neuromas, periaxillary sympathectomy, subarachnoid injection of alcohol, and posterior root section. There are two procedures which have proved to be of value: the first for painful neuroma, and the second for causalgic states. A painful neuroma may be resected once if the pain is localized and if the pain is relieved by procaine block. At operation there are three ways of dealing with the neuroma: (1) the injection of 20 per cent formalin into the stump; (2) pulling the nerve through a drill hole in a neighboring bone; and (3) wrapping the nerve in a cuff of tantalum foil.

In the causalgic states the diagnostic test is paravertebral procaine block, and in the event that the pain is relieved during the period of the block, good results may be expected from appropriate sympathectomy. Sympathectomy however is more effective when pain is principally in the peripheral part of the limb.

There are cases of phantom limb in which the relatively harmless procedures described are not satisfactory and recourse must be had to operations on the central nervous system. There is no unanimity of opinions about the efficacy of these. Cordotomy and either postcentral cortical resection or lobotomy are possible methods of attack. With regard to cordotomy a diagnostic test can be done by using spinal anesthesia for the lower extremity and brachial plexus block for the upper extremity. A more

careful preliminary use of these diagnostic tests will increase the satisfactory results following cordotomy. In cases in which the pain is definitely of central origin resection of the postcentral cortex appropriate to the involved area of pain may give relief by removing the sensory cells which give rise to the phantom sensation. Lobotomy or interruption of the frontal association fibers may remove the patient's introspection and concentration on his defect.

ADRIAN VERBROEGHEN M.D.

BRAIN AND ITS COVERINGS CRANIAL NERVES

Clarkson P., and Schorstein, J.: The Treatment of Denuded Skull Table. *Brit. M J* 1945 2 422

The treatment of widely denuded areas of the calvarium has usually required a lengthy period of hospitalization and care because healthy granulation tissue must grow from the diploic spaces after numerous burr holes are placed through the external table.

The authors present a technique of early skin grafting which had been used in 3 cases with complete loss of scalp and pericranium over the area. Burr holes were placed only through the outer table arranged in a mosaic pattern, and connected with grooves produced with a gauge. The outer table was then chiseled away in small blocks to expose the entire diploic of the denuded area. Hemostasis was obtained with hot packs; however, bone wax was used in 1 case without detriment. Thin patch grafts 1 cm. square were then placed directly upon the diploic covered by a nonadherent material and maintained in place by tulle gras wool or crepe. The dressings were removed on the fourth day and then changed daily until healing ensued. Good results were obtained in all 3 cases. JACK I. WOOD M.D.

Wachowski, T. J., and Chenuault, H.: Degenerative Effects of Large Doses of Roentgen Rays on the Human Brain. *Radiology* 1945 45 33

The authors have reviewed the literature from the standpoint of the effects of roentgen rays on the human brain. There is a good deal of evidence to indicate that large doses of roentgen rays produced definite degenerative changes in the brain. These degenerative changes in some instances were reported in association with an increase of lipochrome substance within the cells. The nerve cells were affected most and the neuroglia to a lesser extent. The blood vessels for the most part seemed unaffected. Such changes were reported following the use of 12,645 r (air) through multiple portals over a period of 5 months.

More marked degenerative changes following even larger doses included alterations in the astrocytes, microglia, and possibly the oligodendroglia.

The authors have reported on 6 patients in 4 of whom the tumors were histologically verified prior to irradiation. Treatment consisted of the use of from 3 to 5 portals with an initial dose of 150 r increased over a few days to 300 r. The shorter series ran 32 days, totaling 9,000 r (air) and 6,150 r tumor dose; the longer series took 106 days with 14,540 r (air) and 8,800 r tumor dose.

Three of the cases came to autopsy and these showed extensive degenerative changes in the nerve tissue.

Pathological studies reported by the authors indicate that following irradiation of the brain there are widespread changes which affect all the cellular elements. The nerve cells of the cerebral cortex are almost universally degenerated, the least change being seen in the large Betz cells of the motor cortex. The neuroglial cells, especially the protoplasmic cells of the cortex, are fragmented and the fibrillary neuroglial cells are swollen. Fat has accumulated in their cytoplasm.

There is an increase in the number of microglia cells of huge size with their processes laden with fat or greenish pigment. The capillaries and other small blood vessels have excessive amounts of fat in the endothelial and adventitial cells. The myelin sheaths are swollen and fragmented giving rise to accumulations of fat in the white substance. The nerve fibers are also swollen and fragmented. In the adventitial spaces are accumulations of lymphocytes, plasma cells and macrophages. There is therefore a degenerative change affecting all parts of the brain and all its cellular elements even of the cerebellum.

HOWARD A. BROWN, M.D.

O'Connell, J. E. A.: *Lumbar Puncture in the Treatment of Penetrating Wounds of the Brain.* *Lancet* Lond. 1945 249 339.

The dangers of lumbar puncture in intracranial hypertension have been amply set forth but the value of this procedure for control has rarely been given a great deal of consideration. Although most neurosurgeons use spinal puncture in head injuries, the specific theory and indications have not been the subject of a special discussion. Penetrating wounds of the head provide material from which such a discussion may be launched. Of over 1,000 head injuries dealt with in the post hospital where the author was stationed, 150 were penetrating wounds. Various conditions arise in which lumbar puncture may be of service, namely, in post operative reduction of cerebral pressure in scalp wounds with penetration, in removal of intracerebral foreign bodies, in post traumatic cerebral abscess in untreated wounds seen after infection has set in, and in the treatment of progressive cerebral fungation.

There may be sufficient pressure from cerebral herniation on a scalp wound to cause anxiety about the strength of the suture line. When primary healing has taken place the danger of cerebral fungus is passed and that anxiety need no longer be entertained. During the period of healing lumbar puncture

will be found of value to reduce pressure on the wound. Cerebral herniation may have occurred before the patient is available for treatment and the brain wound may contain various bone and metallic fragments which are inaccessible partly because of the herniation. The track containing foreign bodies may be compressed in the herniated brain tissue. Lumbar puncture under these circumstances will reduce the herniation and open up the track of a driven fragment which makes their essential complete removal much easier. The puncture is done immediately before the débridement is begun. Even much the same situation exists when a post traumatic abscess has formed and the sinus track is compressed in a cerebral herniation. Lumbar puncture immediately before operation will open up the track and facilitate drainage and packing of the abscess cavity. The author packs such a cavity with rubber sheeting in which strip gauze is inserted forming a tampon which provides drainage outside of the rubber. The sheeting is changed frequently following lumbar puncture. Penicillin is used locally.

A patient with a penetrating wound may be considered too ill for surgery when first seen and, later after a few days survival, his untreated wound may be infected. Such a patient is almost certain to have a cerebral herniation through a dural defect. Lumbar puncture may be used to open up the track, which facilitates cleansing the wound and drawing it with a rubber sheeting tampon.

Progressive cerebral fungation is an obstinate and difficult complication of a large penetrating wound of the head. In this case the herniation may contain part of one of the lateral ventricles. The dilated distorted ventricle may in fact be the cause of the herniation. Lumbar puncture diligently used may cause the withdrawal of the herniation and ventricle into the cranial cavity.

In the cases under discussion, the lumbar puncture was done under anesthesia immediately before operation and the level to which the intracranial pressure was lowered depended on the circumstances of the case. After operation puncture was done once a day, the patient's head was kept high, and his fluid intake was regulated. Puncture was not done in cases in which the wound was thought to involve the lateral ventricle for fear of aspirating foreign material into it. Apart from the considerations mentioned lumbar puncture was of value in diagnosis and as a route for the introduction of penicillin. This excellent article is well illustrated and documented with case reports.

ADRIEN VERBURGH, M.D.

Martin, H. and Reese, A. B.: *Treatment of Bilateral Retinoblastoma (Retinal Glioma) Surgically and by Irradiation; Report on Progress.* *Arch. Ophth.* Chic., 1945 33 429.

The authors have made a special study of bilateral retinoblastoma and have offered a previous report one in 1936 with a discussion of 6 cases, and one in 1942 in which 4 new cases were added. This article

is a report of progress with regard both to the technique of treatment and examination and also the end-results of such treatment. Fourteen additional cases are discussed.

The five-year end results in 9 cases treated surgically and by irradiation are of interest in that 6 of 8 patients who were treated prior to 1939 are still living. In 1 case the cause of death may not have been connected with the original growth. Two of the 6 living patients can see and 4 cannot.

A comprehensive table showing the location, size of the tumor, treatment and end result in those 24 cases is appended. The first sign of the tumor is usually a white light reflex in the pupillary region of the eye; this may lead to examination and recognition of the disease which is usually bilateral. Tumors that occupy more than one quadrant of the fundus have a poor prognosis. Raised nodular tumors are unfavorable. Irradiation is relied upon to a great extent and the signs of improvement under this method are described; they consist chiefly of a gradual increase in the calcium content of the tumor to the point where it has the appearance of a single nodular mass of calcium resembling cottage cheese. The roentgen rays must be used with caution for the eye has a limited tolerance to them. The precise method to be used is described in detail; the single dose is about 400 roentgens and the maximum total dose 8 000 roentgens $\times 2$.

It is recommended that the child be frequently re-examined and this is best done under light chloroform anesthesia. ADRIEN VERBRUGHEM M.D.

SPINAL CORD AND ITS COVERINGS

Nielsen A., and Patterson G. H. Spinal Cord Tumors in Children; A Study of 3 Cases of Ependymoma. *J. Pediat. S. Louis*, 1945 27 515

Most medical men are of the opinion after reading authoritative works on spinal-cord tumors that these are rare in children. Among the older writers however there is evidence that these lesions occurred more frequently in children. In modern works the percentage varies from 1 to 5 per cent, but in older works it varies from 10 to 13 per cent.

The present article has to do with 3 cases of spinal cord ependymomas in children. In 1 of these the result was very satisfactory in that the patient is still alive after three and one-half years. The diagnostic problem is the important one for in all 3 of the cases reported the preliminary diagnosis was incorrect and treatment was instituted without improvement. Tuberculosis and poliomyelitis were the entities mistaken for the spinal-cord tumor in these 3 cases. The history however should have given a clue, for in all of the cases the trouble commenced with pain and stiffness of the back and finally led to unmistakable symptoms. In all of the cases the spinal fluid showed increased protein, xanthochromia, or complete block, and it is probable that the puncture should have been undertaken for diagnostic purposes at a much earlier date.

An examination of the roentgenograms of the spines showed that in all 3 there were definite changes of the pedicles which if properly assessed in the first place would have at least suggested the true nature of the complaint.

The 3 case reports are submitted and are carefully documented; they should be found useful to those who are interested in this subject.

ADRIEN VERBRUGHEM M.D.

SYMPATHETIC NERVES

Zadikoff J. J., and Grayce, I.: A Case of Carotid Sinus Syndrome Relieved By Operation. *Clin. Proc. Cape Town* 1945 4 253

The carotid-sinus syndrome is one of the causes of syncope, and recently there has been a tendency to deal with this condition by non-surgical methods. This article contains a brief review of the pertinent literature on the subject and describes a case in which the patient was relieved by surgical measures.

Electrocardiographic changes were noted during pressure on the hypersensitive right carotid sinus of the patient. A bradycardia of 44 per minute was produced by pressure on the sinus and at least one asystole lasting 2½ seconds was recorded. No attempt was made to make preoperative tests with atropine or to novocainize the bifurcation of the common carotid artery. A penarterial sympathectomy was performed from 2 inches below the bifurcation to 2 inches above it; thus the three carotid vessels were stripped for at least 2 inches. The patient had no further attacks of syncope and pressure on the affected sinus did not result in any consequential changes 6 months after the operation.

The authors believe that surgical intervention has a distinct place in the treatment of this syndrome and that it must be considered in all cases of syncope. The diagnosis rests on the ability to reproduce the syndrome by pressure on the sensitive sinus.

ADRIEN VERBRUGHEM M.D.

Hines, E. A. Jr. and Christiansen N. A.: Raynaud's Disease among Men. *J. Am. M. Ass.* 1945 129 1

The occurrence of Raynaud's disease in men is reported in a series of cases dating from January, 1930 to December, 1942 at the Mayo Clinic. The average incidence has been 21 per cent in males and 79 per cent in females. The authors stress the importance of accurate criteria in making the diagnosis of Raynaud's disease.

Raynaud's phenomenon is described as the occurrence of intermittent episodes due to a functional vascular disturbance either primary or secondary resulting in color changes of the extremities—principally the fingers and toes and less frequently the nose and ears. These episodes are initiated by exposure to cold, and less frequently by nervous or emotional strain and stress. When the condition is primary it may be referred to as Raynaud's disease.

A working basis for the diagnosis of this condition has been set forth in a previous publication by Allen and Brown, and is summarized as follows:

- 1 Episodes of Raynaud's phenomenon excited by cold or emotion
- 2 Bilaterality of Raynaud's phenomenon
- 3 Absence of gangrene or if it is present its limitation to minimal grades of cutaneous gangrene
- 4 Absence of any primary disease which might be causal such as occlusive disease of the arteries cervical rib or organic disease involving the nervous system
- 5 Symptoms of 3 years or longer duration

Symptoms in this series were reported as appearing as early as the age of 5 years and as late as 63 years. In 91 per cent of the cases exhibiting Raynaud's phenomenon the symptoms were recorded as having been present for 3 years. In 59 per cent the symptoms were present for 6 years and in 11 per cent they were present for 31 years or longer. The early establishment of a correct diagnosis of Raynaud's disease is emphasized; this condition is considered more benign than the more serious diseases which have Raynaud's phenomenon as a secondary manifestation such as thromboangitis obliterans, arteriosclerosis obliterans and scleroderma.

The treatment depends upon the degree of incapacitation, and conservative therapy is recommended when the disease is not too incapacitating. The patient should avoid exposure to cold or sudden changes of temperature, and should use warm, protective clothing. The direct relationship of tobacco to this condition is not clear but it is advised that

patients with this condition abstain from the use of it.

Sympathectomy was done in 3 cases, with prompt relief.

A detailed study of 100 unselected cases among 181 male patients was made; further studies were conducted on 69 of whom 33 per cent, having had conservative treatment, showed improvement, 41 per cent were unchanged, and 23 per cent were worse.

HOWARD A. BROWN, M.D.

MISCELLANEOUS

Nadler S. B.: Paroxysmal Headache. *J. Am. M. Ass.*, 1945, 159, 334.

Eight cases of paroxysmal temporal headache are reported; they were treated surgically. Characteristic attacks started with periodic throbbing pain in the right, left, or both temporal regions, radiating to the frontoparietal and postauricular areas. Gastrointestinal manifestations were frequent during the attacks.

Digital compression on the temporal artery on the affected side abolished the throbbing pain and the greater part of the continuous dull headache. The area in which digital compression afforded maximum relief was injected with 5 c.c. of 1 per cent procaine hydrochloride and this afforded complete relief to the majority of the patients.

Ligation and section of the temporal artery was then performed under general anesthesia, with reported relief of headache varying from 3 to 11 months after operation at the time of this report.

HOWARD A. BROWN, M.D.

SURGERY OF THE THORAX

CHEST WALL AND BREAST

Schle, E.: On the Prognosis of the Papilloma of the Lactiferous Ducts. *Acta chir scand.* 1942 87 417

There has been a very considerable disagreement among pathological anatomists as to whether papilloma of the lactiferous ducts is benign or malignant. Some authorities hold that as many as 50 per cent of these papillomas develop into cancer while others maintain that it has never been proved that they represent precancerous conditions.

The only practical way to settle the question is to re-examine patients who have had papillomas of the lactiferous ducts and on whom only local extirpation of the tumors has been performed. With this object in view the author examined 53 patients on whom operation had been performed for this form of papilloma. Amputation of the breast had been performed in 26 of the cases however and these were not considered in his study. In the 27 other cases local extirpation had been performed. In 8 of these cases histological examination showed very marked atypia of the cells while in the 19 others the cells were only moderately atypical. A number of microphotographs showing the histological findings are given. Re-examinations were made after from 2½ to 8 years and only 1 case showed a recurrence. This had appeared after 4½ years and was benign the picture being that of papillomatous adenoma.

The author concludes therefore that it is not too great a risk to remove a papilloma of the lactiferous ducts by local extirpation. This spares an organ that is of great importance to the patient both physiologically and esthetically. It is advisable however to keep the patient under medical observation for a year or two after operation so that any recurrence may be detected early. AUDREY G. MORGAN M.D.

TRACHEA, LUNGS, AND PLEURA

Gusterson F. R.: Postoperative Chest Complications Controlled Study in Hernia and Meniscectomy Operations. *Lancet*, Lond., 1945 249 431

Two hundred soldiers were operated upon in a military hospital in the course of 2 years by practically standard procedures and under practically identical conditions—100 for hernia and the other 100 which were included in this study merely as controls, were subjected to meniscectomy. In each of these two groups 50 of the patients were given ether anesthesia and the other 50 were given gas-oxygen. For the ether the Oxford vaporizer was used which admits of a light, uniform administration the nitrous oxide and oxygen were administered in a closed circuit no suboxygenation being allowed.

All patients were examined the day before operation with special attention to the smokers cough reported by Morton (*Lancet* Lond., 1944 1 368). When the subjects had a history of recent coryza, they were not operated upon for at least a week after the symptoms had subsided. Those with a history of chronic bronchitis with sputum or with any chronic respiratory disease such as mild emphysema were all classed as having major preoperative respiratory complications, even though there were no signs of active disease. Early exercises were insisted upon and the stay in bed was 14 days in all cases. During the first 7 days the temperatures were recorded every four hours. The number of times a patient vomited was recorded by observation not by the patient's statements.

It was found that following herniorrhaphy temperatures from 99 F to 101 F inclusive developed in 14, 21 and 7 cases done under ether anesthesia, and in 15, 22 and 6 cases done under gas-oxygen anesthesia. Eight of the patients operated upon under ether and 7 under gas-oxygen developed temperatures of over 101 F. Of the patients subjected to meniscectomy, none developed a temperature of more than 101 F. 5 under ether anesthesia but none under gas-oxygen, developed temperatures of 101 F. Twenty three under ether and 28 under gas-oxygen developed temperatures of 100 F and 22 each under ether and under gas-oxygen had temperatures of 99 F.

Thus, it was found that in neither series was the incidence of chest complications any higher whether ether or gas-oxygen anesthesia was used. There was a higher incidence of preoperative chest complications (43 minor 7 major) in the hernia series than in the meniscectomies (15 minor 2 major), the number of cases developing major chest conditions was roughly doubled following herniorrhaphy irrespective of the anesthetic agent, which suggested a distinct liability to postoperative chest complications in the cases of hernia. However in no case were the full classical signs of lobar atelectasis found perhaps because treatment (see original article) was instituted at once. The presence of such a high incidence of preoperative chest complications in cases suggesting a liability to postoperative chest complications does, however, emphasize the need of a careful survey of each patient before operation and the fact that reliance must be placed on the careful postoperative routine rather than on the choice of any particular technique of anesthesia if the incidence of postoperative chest morbidity is to be reduced.

The incidence of postoperative vomiting was studied under the impression that patients who did not vomit were more liable to develop a chest condition, and the only postoperative difference which could be attributed to the anesthetic was found to

be a slightly higher incidence of postoperative vomiting after ether.

The author concludes from this study that the use of ether as an anesthetic does not increase the incidence of partial collapse of the lung or of any other chest complication following hernia operations, provided only the lightest necessary plane of anesthesia is maintained.

JOHN W. BRADY, M.D.

Aronovitch M: Medical Treatment of Postoperative Pulmonary Atelectasis. *Canad Med Ass J* 1945 53 2

Postoperative atelectasis is still the most important acute collapse of the lung which may occur. Its treatment properly consists in prevention. This entails proper preoperative hygiene of the nose and throat and the careful selection of cases for surgery. Very important however is the immediate postoperative care which is usually administered by the anesthetist and usually consists of carbon dioxide inhalations and the aspiration of mucus from the nasopharynx, throat and deeper structures if necessary.

In spite of all precautions pulmonary collapse will still occur in a certain proportion of cases. The immediate cause of the collapse is conceded to be a plug of mucus or fibrin and mucus which seals one of the larger or smaller bronchi. The contributing factors to this event may be many and accordingly various theories have been advanced to explain why this plug should occasionally occur.

No matter how the bronchial plug is formed the result is the same. Air in the alveoli distal to the plug is absorbed and collapse of these alveoli occurs. The clinician is then confronted with a patient who exhibits the familiar picture of postoperative atelectasis with its fever, shallow respirations, cyanosis and chest pain.

The problem is to remove the plug. Once this is gone the affected alveoli will usually re-expand and all symptoms disappear. Bronchoscopic aspiration can of course be done and must always remain as the final method of choice when others fail, but it is usually unnecessary to resort to this measure which is in itself an operation.

Sometimes exceedingly simple procedures such as a slap on the back, encouraging a hard coughing spell, or posturing the patient will dislodge a bronchial plug. Often however these measures fail and in such cases a more detailed knowledge of the mechanics of the bronchial tree may aid in rational therapy.

Once the plug firmly in the bronchus and atelectasis has occurred it may be assumed that there is a great deal of spasm. Indeed it is this bronchial spasm which probably contributes greatly to the shallow respirations and cyanosis seen in these cases.

Bronchospasm is an important factor which must be considered and must be eliminated in any rational treatment.

Another important fact which must be considered is the dry, viscid nature of the plug.

Two other factors must be considered. One is gravity but a more important factor is the intra-bronchial pressure proximal and distal to the plug. Atelectasis having taken place by absorption of the air distal to the plug, intra-bronchial pressure and pressure from the surrounding structures will tend to drive the plug in deeper. An expulsive force to drive the plug out of the bronchus should therefore be considered.

An attempt can be made to remedy each of these factors and the resultant combined action is often successful in curing the atelectasis.

It is not expected that the plug itself once formed, can be easily liquefied but if the bronchial mucosa can be made to secrete a thin watery fluid this will surround the adherent plug and the latter will then tend to float off. One-half ounce of mixture of ammonium chloride every 4 hours is helpful in achieving this objective.

The most powerful agent in relaxing the bronchial musculature is adrenaline. Ephedrine is satisfactory, however. Given hypodermically in a dosage of 1/4 gr. it has proved very efficacious. The bronchial dilator is best given some time after the expectorant so that bronchial secretion is already present. Twenty minutes or thereabouts should be allowed between the oral expectorant and the hypodermic bronchodilator which is repeated every 4 hours.

Gravity and expulsive force can now be called in to aid in the expulsion of the plug by posturing the patient and encouraging him to cough for some 10 minutes after the bronchodilator is given. This is to be repeated hourly. This method will not succeed in all cases but it is well worth a trial. If it fails and the patient has no relief after 24 hours bronchoscopic aspiration can always be done. There is no risk in delaying bronchoscopic aspiration for this length of time even if the patient is somewhat uncomfortable provided the possibility of lung suppuration can be minimized. Adequate prophylactic doses of sulfathiazole or sulfadiazine should therefore be given with this therapy.

Statistics are presented for which this method is employed at the Montreal Military Hospital. The good results.

JOHN E. KIRKPATRICK, M.D.

Kay, E. B. and Meade R. H., Jr: Penicillin in Infections of the Lungs and Bronchi. *J. A. M. A.* 1945 29 300.

Kay and Meade treated 93 patients having chronic infections of the lungs and bronchi with penicillin. Forty five of these patients had bronchiectasis, 17 had lung abscesses, 6 had suppurative pneumonitis, 19 had chronic bronchitis and 5 fungous infections.

Penicillin is of unparalleled value in the treatment of acute pulmonary infections but as chronicity develops it becomes less effective. Chronicity in pulmonary infections introduces factors not found during the acute stage, which influence the efficacy of penicillin therapy. They are the mechanical factors of tissue destruction, fibrosis, vascularity and bronchial occlusion.

Penicillin appears to be of value in the treatment of acute exacerbations of chronic infections superimposed attacks of bronchopneumonia, chronic bronchitis, minimal bronchiectasis and advanced bronchiectasis too widespread for pulmonary resection. It is also of value in preparing the patient for operation as an adjunct to surgery making possible operative intervention otherwise impossible and in decreasing the postoperative complications.

Penicillin is of no permanent value in the treatment of advanced bronchiectasis nor should pulmonary resection be withheld when indicated because of the false sense of security resulting from temporary benefit.

In the treatment of pulmonary suppuration, chronic lung abscesses and fungous infections the chief value of penicillin is its ability to decrease the general manifestations of toxicity to promote symptomatic improvement and to prepare the patient for operative intervention.

The intratracheal administration of penicillin in the treatment of chronic bronchitis and bronchiectasis appeared to give more benefit in many cases than intramuscular administration. As much as from 30,000 to 50,000 Oxford units of penicillin can be applied daily in one application to the tracheobronchial tree. Excellent results were obtained in patients with chronic bronchitis and minimal bronchiectasis by the use of this method.

STEPHEN A. ZEFMAN M.D.

Randolph V. S.: The Drainage of Cavities in Bilateral Pulmonary Tuberculosis. *J. Thorac. Surg.* 1945 14 395

In bilateral pulmonary tuberculosis the treatment of cavities is often the most serious problem and it is frequently insurmountable. Many patients with bilateral disease have been successfully treated with bilateral artificial pneumothorax. It is often necessary to sever adhesions on one or both sides of the chest in order to make the collapse successful.

When pneumothorax cannot be used because of too extensive adhesions it is necessary when considering other forms of collapse to study the patient from the standpoint of preserving adequate lung space. In the treatment of cavities at or very near the apex, bilateral extrapleural pneumolysis and extrapleural pneumothorax have rarely been employed successfully. In exceptional cases in which sufficient lung space may be saved bilateral thoracoplasty has been employed.

However if the cavity to be treated lies in the lower part of the upper lobe, a middle lobe, or the upper part of the lower lobe, these collapse methods are not available because collapsing the cavity will also collapse too much useful lung. In these cases some type of cavity drainage must be used. Open drainage of tuberculous cavities has ordinarily been disastrous but by the use of closed catheter drainage many cavity closures have been reported, however in many cases there has been a reopening of the cavities after the original closure.

In 2 cases of bilateral pulmonary tuberculosis which were not suitable for any form of collapse therapy the Eloesser flap drainage was used. In both cases the results were excellent. The field of this operation is definitely limited. It has hitherto been used on only one side of the chest when it has been possible to control the tuberculosis on the other side. However it may be of value for use on both sides of the chest. This form of drainage has the advantage of being a simple procedure and one which does not require close continuous aftercare.

SAMUEL KAHN M.D.

Thomas, J. W., Van Orstrand H. S., and Tomlinson C.: The Treatment of Bronchiectasis with Chemotherapy and Allergy Management. *Ann. Int. Med.* 1945 23 405

An evaluation by follow up examination and questionnaires was made of 75 cases of bronchiectasis treated by sulfonamides and or allergic management. In 13 of these cases operations had been recommended but they had been refused or postponed the remaining cases had been considered non-surgical because of minimal or advanced disease age and general conditions. The periods of observation varied from 4 months to 5 years, the majority of the cases being observed for 2 years at least, most of the patients had had the disease 5 years or longer.

In 57 cases, lipiodol bronchography and bronchoscopy established the diagnosis while in the remainder of the cases the diagnosis was made by means of the history, physical examination, absence of tubercle bacilli and fungi in the sputum and stereoscopic and plain chest films (which are at best only suggestive evidence). In one half of the cases the nonhemolytic streptococcus, streptococcus viridans and the hemolytic streptococcus were found, one fourth showed the pneumococcus and some showed the fusiform bacillus, spirochaeta, neisseria, catarrhalis, staphylococcus albus and haemophilus influenzae. Fifty five of the patients had associated major respiratory allergy including bronchial asthma, perennial allergic bronchitis and severe perennial allergic rhinitis.

Treatment consisted of palliative measures to reduce pulmonary infection to a minimum and to irradiate obstruction i.e. treatment of sinusitis and oral sepsis, rest, adequate diet and vitamins and postural drainage. Sulfonadiazine or sulfathiazole was used in most instances, the average courses were 7.7 gr. (0.5 gm.) four times daily for 4 weeks repeated from 0 to 9 times at intervals of from three to four months. Allergy management consisted of thorough investigation and avoidance of important offending allergens in the patients' environment, dietary restrictions, hyposensitization with extracts and autogenous vaccinations. These measures were followed for periods varying from 4 months to 3½ years.

The summary reveals the following results in addition to the preceding facts:

1. Twenty-three cases received sulfonamide drugs as the chief or only therapeutic measure. Twenty two of these showed definite improvement with reduction of cough and expectoration while under treatment.

2. Twenty-one cases were treated chiefly or wholly with allergy management. Fifteen of this group showed frank improvement with reduction in cough and expectoration.

3. In 31 cases combined allergy and sulfonamide therapy was used. Twenty-six showed at least from 25 to 100 per cent improvement in cough and expectoration.

4. Recurrences of symptoms of original severity were frequently noted following acute respiratory infections, cessation of allergy management, or in some cases when infrequent courses of sulfonamide drugs were used.

JAY BARTLETT, M.D.

Timney W. S., and McDonald, J. R.: Pulmonary Metastasis of Carcinoma Diagnosed by Bronchoscopy. *Minnesota M.* 1945 18 554

In 3 cases a metastatic lesion from carcinoma ulcerated through some portion of the tracheobronchial mucosa. The first case was probably an example of direct invasion of the trachea by carcinoma of the thyroid and the second case was an example of carcinoma of the breast with metastasis to the bronchial mucosa.

The third case was the most interesting one in this series. The metastatic lesion in the lung was diagnosed 3 years after nephrectomy for hypernephroma and there was no evidence of recurrence or metastasis 4 years after pneumonectomy for the metastatic tumor.

In all of these cases metastasis to the tracheobronchial tree was diagnosed on bronchoscopic examination and biopsy of tissue obtained bronchoscopically confirmed the diagnosis.

Griese, D. F., McDonald, J. R., and Giegert, O. T.: The Proximal Extension of Carcinoma of the Lung in the Bronchial Wall. *J. Thorac. Surg.* 1945, 14 362

This study was based on 55 cases of carcinoma of the lung in which the surgical specimens were examined microscopically to determine the proximal extension of the malignant lesion along the bronchial wall. Only 30 of the 55 cases were included in the final survey. In the remaining 25 cases the specimens had been mutilated by previous investigation or the carcinoma obviously did not involve a bronchus. The following types of tumor were encountered in the 30 cases: a squamous cell epithelioma in 16 or 53 per cent, an adenocarcinoma in 6 or 20 per cent, an adenoma in 7 or 23 per cent, and an anaplastic type of carcinoma in 1 case or 3 per cent respectively.

Although adenocarcinomas are considered more malignant than are squamous cell epitheliomas, the tumor had extended proximally in 10, or 62 per cent of the 16 cases of squamous cell epithelioma as com-

pared with 3 or 50 per cent of the 6 cases of adenocarcinoma. The adenocarcinomas however, extended a greater average distance proximally than did the squamous cell epitheliomas. Of the 16 squamous epitheliomas 5 were grade 2 and 11 were grade 3. Of the 6 adenocarcinomas, 1 was grade 2, 4 were grade 3 and 1 was grade 4. Proximal extension did not occur in the case in which the adenocarcinoma was grade 4. This is in agreement with the finding of New and Fletcher in cases of carcinoma of the larynx, and with that of Conway and Broders in cases of carcinoma of the urinary bladder, namely that carcinomas that are of grade 4 are not as prone to spread by direct extension as are those of grade 3.

There was no evidence of extension in the 7 cases of adenoma or in the case in which an anaplastic type of carcinoma was encountered.

In 8 cases extension occurred in the outer fibrous coat only. In 3, it occurred in the mucosal coat only; in 1 case it occurred in the submucosa and in 1, it occurred in both the submucosa and the outer fibrous coat.

When dealing with adenocarcinomas the surgeon should, if anatomically possible, sever the bronchus more than 3 cm. proximal from the gross limits of the lesion. If the tumor is a squamous cell epithelioma, a safe distance to sever the bronchus would be at least 1.5 cm.

Neuhof, H., and Stata, D.: Putrid Empyema without Foul Sputum. *Surgery* 1945 18 411

The diagnosis of putrid empyema in the absence of foul sputum or other evidence of a pulmonary abscess is difficult. The lesion should be suspected and efforts at diagnosis should continue as long as a given set of clinical manifestations are present. These consist primarily of outstanding and persistent chest pain, slight cough and expectoration, and an illness which is severe at least in the initial stage. Cough may be absent, the course may be chronic. The discovery of foul pus by aspiration of the pleura is the sole method of establishing the diagnosis. This discovery will often be a surprise. Wide drainage of the main lesion and its ramifications will effect a cure unless the diagnosis has been delayed too long. Although a pulmonary abscess is not demonstrable, a putrid pulmonary abscess is the precursor of "surprise" putrid empyema.

SHEPHERD A. ZIEGLER, M.D.

Collis, J. L., Davison, M. H. A., and Smith, P. R.: The Management of Traumatic Pyothorax. *Lancet, Lond.* 1945 245 778.

The 44 cases on which this article is based are instances of total or almost total pyothorax and do not include patients with early infected hemothorax. The high mortality of 27 per cent (12 cases) emphasizes the importance of this condition. The authors experience has led them to believe that a localized empyema is sometimes unavoidable, but that total pyothorax with the possible exception of cases associated with esophageal injury or very virulent

organisms such as the hemolytic clostridium welchii is an avoidable condition. In other words if pulmonary expansion is effected and maintained from the onset of treatment infection can produce only a localized empyema.

In cases of closed pyothorax aspiration is carried out for the first few days penicillin being introduced into the pleura after aspiration on alternate days. The aspirations may be necessary daily or on alternate days according to the rate of collection of fluid, and are followed every forty-eight hours by the introduction into the pleural cavity of 50,000 units of penicillin in 2 c.c. of water. At the last aspiration before drainage 20 c.c. of iodized poppy seed oil is introduced and posteroanterior and lateral roentgenograms are taken. A portion of the ninth or tenth rib is then resected, all clot removed and drainage instituted just under the lateral edge of the erector spinae. Breathing exercises are started at once. The incision is vertical for two reasons. The first is that it heals better this way if a horizontal incision is made serous fluid or pus can collect under the lower edge but if the incision is vertical outward drainage takes place more readily along the line of the incision. The second reason is that after a vertical incision is made it is easy to resect a portion of the rib one higher or lower if the first rib resection is found to be unsuitably placed. Although local anesthesia was used at first for these operations it has been given up in favor of cyclopropane.

A method of two-tube drainage with an additional apical tube allows the cavity to be washed out and prevents the drain from becoming blocked.

JOSEPH K. NARAY, M.D.

Hirschfeld, J. W. Bugge, C. W. Abbott, W. E., and Pilling, M. A.: Penicillin in the Treatment of Empyema. *J. Am. M. Ass.* 1945 128 577

Penicillin is a powerful antibacterial agent and almost nontoxic for man. It is not inhibited by pus or other products of tissue destruction. After intravenous or intramuscular administration penicillin penetrates poorly into collections of pus, but if it is injected directly into an abscess considerable concentrations persist for from 24 to 48 hours.

In order to effect a cure of pleural empyema by penicillin therapy alone the causative bacteria must be susceptible to penicillin, the empyema cavity must not be loculated nor contain pieces of necrotic lung or large clots of fibrin, a persistent bronchial fistula must not be present (because of constant re-infection of the cavity) and the lungs must be capable of re-expanding in order to obliterate the cavity. If the pleura becomes so thick that the lung cannot re-expand, operation is necessary in order to move the chest wall in to meet the lung.

Thirteen cases are reported. In spite of the instillations of 50,000 units of penicillin after aspirations several cases required rib resection. In 1 case, this was required because of the reappearance of pneumococci after three weeks of very intensive

penicillin therapy both intrapleural and intramuscular. In 2 other cases multiple bronchopleural fistulas prevented complete re-expansion of the lung and low grade fever persisted. In these cases penicillin considerably improved the patient's general condition and made rib resection a safe procedure. In a 2 year-old white girl, rib resection was performed because of lack of improvement after 6 days of penicillin therapy. This was followed by a rapid drop of temperature to normal and steady improvement. In another case infection of the chest wall following repeated aspirations made rib resection advisable.

Two patients in this series of 13 died as the result of empyema, 1 during the course of penicillin treatment and the other after rib resection. The immediate causes of death were pulmonary hemorrhage and multiple pulmonary infarcts respectively.

ARTHUR J. LEEVER, M.D.

HEART AND PERICARDIUM

Lam, C. R.: Large Anomalous Vein (Left Vena Cava) Encountered in Operation for Ligation of Patent Ductus Arteriosus. *J. Thorac. Surg.*, 1945 14 393

During the course of operation on a patient suffering from a patent ductus arteriosus with subacute bacterial endocarditis a large anomalous vein was

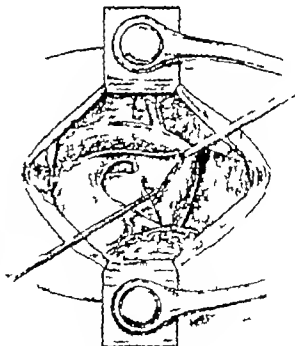


Fig. 1. Schematic diagrammatic view of findings at operation showing the "left vena cava" being held away with the tape to expose the ductus arteriosus, which is in the curve of the aneurysm needle.

seen lying on the aorta, and following a course parallel to it. Its diameter was only slightly less than that of the aorta. Medially it disappeared into the areolar tissue of the mediastinum and appeared to enter the pericardium to the right of the aorta. It received at least one large branch from the neck. There was no pulsation or thrill in the vein and it collapsed with slight pressure.

Penitcut left superior vena cava has previously been reported but no mention has hitherto been made of a left inferior vena cava. The author believes that the simplest explanation for the vein in this case is to assume that it represents the left innominate vein and persistence of a left cardiac vein.

SAMUEL KATZ, M.D.

Urschel D. L., Bondy P. R., and Saitley S. M.: Acute Pericarditis. *England J. M.* 1945 233 399.

Eight cases of acute pericarditis were studied within three months at the Battery General Hospital, Rome, Georgia. The clinical x-ray and electrocardiographic alterations followed variable sequences in the different cases, variations incompletely described in textbooks. Since the diagnosis of acute pericarditis is often difficult, the authors present these cases to emphasize the variable sequence of x-ray, clinical, and electrocardiographic findings and also to demonstrate the relatively benign nature of certain cases of pericarditis when treated by modern methods.

Scott, Feil, and Katz, in 1929 first described the RS-T elevation occurring early in a case of hemopericardium and in one of purulent pericarditis, attributing it to myocardial ischemia produced by pressure. These changes indicate recent effusion or a gross effusion which will not allow further stretching of the pericardium. Foulger and Foulger, in 1930, showed that this change was temporary since the electrocardiogram returns to normal unless the intrapericardial pressure is maintained. Fowler, Rathe, and Smith in 1933 correlated the T wave changes in experimental pericarditis with the inflammatory reaction in the subepicardial myocardium. They also showed that when the myocarditis subsided and the inflamed area became fibrous the T waves returned to normal.

Bellet and McMillan, in 1938 showed that the elevation of the RS-T segment was transient and usually associated with rapidly developing types of pericarditis. Inversion of the T wave probably was associated with the subchronic stage and occurred when healing was taking place and the general toxemia was less. Vander Veer and Norris showed that the electrocardiogram might return almost to normal even though the infection and inflammation of the pericardial sac continued and the effusion increased. Elevations of the RS-T segment have not been observed in tuberculous pericarditis.

This series consists of 8 cases, all men between 2 and 27, 6 white and 2 negro. The causative organism was the tubercle bacillus in one case, the meningococcus in another, and the pneumococcus in the third case. The organism was presumed to be tuberculous in 2 cases and rheumatic in 3. These cases were studied by graphs correlating the heart size, the sum of the T waves, the elevation of the RS-T segments, the highest temperature daily, and the time of pericardial friction rubs (Fig. 1). The 8 cases are reported in detail.

Cases 1, 2, and 3, although caused by different etiological agents, graphically presented similar pictures. The heart increased rapidly in size at first, reaching its maximum at ten days. At this time there was little or no change in the electrocardiogram, although some elevation of the RS-T segment had occurred in cases 1 and 2. The maximum T wave inversion occurred in all 3 after the heart returned to original size. T wave inversion sometimes occurs after the temperature has returned to normal and the patient is clinically well. Cases 4 and 5 illustrated this. The T wave total in case 1 was positive throughout and a single electrocardiogram was typical of pericarditis. Only by repeated examinations could the characteristic picture be demonstrated on the graphic chart. This emphasizes the point that the diagnosis of pericarditis by means of electrocardiograms is frequently impossible without repeated examinations.

In case 4 the patient, presumably with tuberculous polyserositis, continued to run a low grade fever after 3 months of illness. The T wave showed a maximum inversion after the heart returned to normal size and remained inverted as long as the patient was under observation during which time the pericarditis continued to be active. In case 5, the T waves remained low for 9 months during which time there was clinical evidence of activity of the rheumatoid process.

Case 6, a severe rheumatic pericarditis, showed that the heart had reached its maximum size and, as returning to normal before the T waves reached their lowest point. The seventh case was the only one to show a maximum T wave inversion before the heart reached its greatest size. Early T wave inversion was followed by nearly isoelectric waves and then by more marked inversion. This rapid electrocardiographic alteration occasionally is seen in acute myocarditis secondary to rheumatic fever or myocardial infarction, but was not seen in the other cases studied. Possibly the early inversion may have been caused by rapidly accumulating fluid in a pericardial sac that could not stretch. This heart never became particularly large in spite of a severe degree of T wave inversion, and no evidence of cardiac tamponade appeared at that time. This patient was first seen on his sixtieth day of illness with a normal sized heart, no fever, T wave inversion, and normal white blood count and sedimentation rate. The T waves became upright in 4 weeks.

Case 8 followed a typical pattern for 3 months. The electrocardiogram showed a rapidly progressive increase in the T wave inversion till the twenty-ninth day. The inversion totaled 11.5 mm. and was

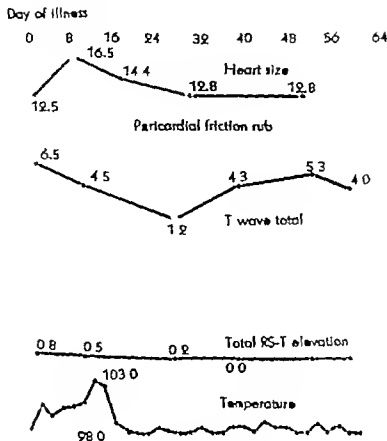


Fig. 1. Graph of findings in case 1.

the most marked in the series. From the twenty-ninth to the fifty-first day it decreased and then remained unchanged. The sedimentation rate was normal by the thirty-first day and the heart was normal by the thirty-eighth day.

The first change generally referred to in textbooks is the elevation of the RS-T segment. It was noted in 5 of 7 cases the highest being 2.0 mm. The change was transient and persisted from 6 to 30 days. It should be carefully searched for in every suspected case of pericardial inflammation since it is the first demonstrable change. However, normal persons may show this finding and therefore serial electrocardiograms are often necessary before an accurate diagnosis can be established.

In this series the maximum T wave inversion came between the sixteenth and forty-third days of disease the average time being the twenty-seventh day. This time interval is important since a patient with acute pericarditis may die long before diagnostic T wave inversion appears. Sometimes the T wave inversion does not involve all four leads and occasionally only one or two are inverted. There is usually some reduction in the total T wave deflection which can be shown by careful measurements in serial electrocardiograms.

In 5 cases the T waves returned to normal in an average of 59 days. In 1 case they remained low for 9 months. In another they remained inverted for 10 weeks and in a third case for 3 months. The authors

are not certain about the significance of persistent T wave inversion long after the temperature, pulse, chest x-ray film, white cell count and sedimentation rate have become normal. These changes may be similar to those in cases of myocardial infarction in which T wave deviations may persist for many months after the acute incident. The authors believe however that persistent inversion must be regarded with caution and for this reason they restrict the patient's activities until the T waves return to normal.

There was no consistent variation in the QRS amplitude although a lowered total deflection has been mentioned as a diagnostic sign in acute pericarditis.

The heart rapidly reached its maximum size in this series. In 2 of the cases the pericardium was tapped to demonstrate fluid. In all of the others there was a roentgenological diagnosis of pericarditis with effusion.

The pericardial friction rub appeared from the second to thirteenth day of disease in this series. It persisted for a period of from 4 to 16 days with an average of 9 days. Only 1 case failed to show a pericardial rub.

As judged from the cases observed there is no significant electrocardiographic difference in the pericarditis caused by rheumatic fever, tuberculosis or pneumococcal or meningococcal infection.

ROBERT R. BRIDGEMAN, M.D.

ESOPHAGUS AND MEDIASTINUM

Adams, R., and Hoover W B.: Benign Tumors of the Esophagus. *J Thorac. Surg* 1945, 4: 479

Benign tumor of the esophagus is a rare disease, when considered in terms of the total number of reported cases the frequency in respect to all esophageal tumors or the percentage of all patients with esophageal symptoms in whom the cause is a benign tumor. However these lesions comprise an important clinical group because they are readily curable by proper surgical management. They are interesting from the standpoint of differential diagnosis, prognosis and rarity and are a challenge to the surgeon who finds pleasure in detecting and correcting the bizarre ailment. The grand total known to us is 97 cases.

From 1933 to 1943 the percentage of cases diagnosed during life was higher, which is explained by the increasingly widespread use of the precision methods of diagnosis—fluoroscopy with barium and esophagoscopy. Also the number of cases discovered and recorded during the last 12 years is over one-half as large as the number of cases reported in the preceding 20 years. Three cases are reported in detail.

The symptoms of all esophageal lesions are so similar that they usually afford little differential diagnostic information. A small tumor rarely causes any symptoms and unless discovered incidentally in the course of fluoroscopic examination its presence ordinarily is not suspected until its size interferes with swallowing. In reviewing cases of carcinoma of the esophagus and the literature of benign esophageal tumors one is impressed with the frequency with which patients have been considered neurotic (globus hystericus) until they began to regurgitate solid food. Dysphagia appears much more slowly with benign tumors than with carcinoma. This is partly explained by the facts that the rate of growth as a rule is much less rapid, and that ulceration, while common and extensive with cancer is late and minimal with benign tumor. Case 3 illustrates the dramatic nature that symptoms may assume if torsion of the pedicle or trauma to the body of a pedunculated benign tumor induces venous obstruction and edema.

The 3 patients had no helpful physical signs but in all of them the roentgenological studies with barium brought out characteristic features of benign esophageal tumors. The walls of the esophagus appear elastic. Peristaltic waves pass through the tumor-bearing region. Even with a large intramural growth in one wall of the esophagus the wall directly opposite is covered with normal mucosa. As shown by the 3 intraluminal cases barium flows evenly around the tumors. As is evident in the roentgenograms in case 1 a thin stream of barium outlined each lateral margin of the growth with no break in the regular mucosal pattern, except at the upper margin of the negative intraluminal shadow where a film of barium seemed to be fitted as a cap over the superior tumor surface. One needs only to compare

these roentgenograms with similar ones showing the narrow, thick, irregular channel in the presence of a carcinoma in the same region to realize how definitely they differ in appearance.

The extirpation of each of these lesions presented some problems peculiar to location, pathology and the anatomy of the esophagus. In case 1 an intramural fibroma it had to be determined with certainty from which organ the tumor arose and after its localization to the wall of the esophagus, it was removed with preservation of an intact mucosa. In case 3 a pedunculated polyp an easy and safe endoscopic operation, instead of a hazardous external operation through the incised cervical esophagus, depended upon the suspension laryngoscope for good exposure and upon the electrocoagulating wire for reliable hemostasis.

In case 2 an intraluminal fibroma, the problem was somewhat more involved. The tumor was too large to be removed endoscopically and it was situated too low to be reached through an incision in the neck. Yet such a tumor must be removed with maintenance of the esophageal continuity or one must accept the alternative of an esophageal resection, cervical esophageal fistula, gastrostomy and external esophagoplasty with the multiple operations, mutilation, and frequent disappointment.

In order to avoid fatal postoperative mediastinitis, rigid asepsis and perfect healing must be achieved. As a contribution to the attainment of these ends, the esophagus should be defunctioned during the periods of preoperative esophageal sterilization and postoperative healing. Finally one must be able to operate in the upper posterior mediastinum, a region admittedly difficult of surgical access with the wide exposure prerequisite to palpatizing and aseptic technique. Each patient recovered without complication.

The literature of benign tumors of the esophagus is reviewed. Various diagnostic and technical problems arising in the management of such cases are discussed.

JOHN E. KIRKPATRICK, M.D.

MISCELLANEOUS

Titche, L. L.: Postbronchoscopic Reactions. *Am. Old. Rhinol.*, 1945, 59: 563.

The use of the bronchoscope for diagnosis and treatment of bronchopulmonary disease is well covered in the literature but there are a few articles emphasizing the harmful effects of this procedure.

Bronchoscopy offers a simple and direct means of investigating bronchopulmonary disease since a lesion of the parenchyma always results in changes of the mucous membrane of the draining bronchus. By watching these changes one can study the character and progress of lung lesions.

Bronchoscopy was performed by the author for diagnosis in cases in which the sputum was negative but the x-rays revealed tuberculosis, as a routine prethoracoplasty procedure, and for diagnosis and treatment of endobronchial tuberculosis. Broncho-

copy was employed for diagnosis in nontuberculous lesions and as part of the treatment of bronchiectasis and of asthmatic patients for the aspiration of secretions.

From January 1, 1943 to January 1, 1945, 361 bronchoscopies were performed on 214 patients. Two hundred and forty-five of these were for 147 tuberculous patients. Of this group, 103 showed a rise in temperature—91 during the first 72 hours and the remaining 12 up to the eighth postbronchoscopic day. This temperature rise varied from $\frac{1}{2}$ degree to 4.55 degrees. In 3 cases the elevation did not persist past the day of the procedure. In 36 the temperature returned to normal the next day, in 17 by the second day and in 15 by the third day.

In addition to this initial rise, 23 cases showed a secondary rise after the temperature returned to normal. In 16 cases this rise occurred between the ninth and thirteenth days following bronchoscopy. In 3 it occurred on the fifth day and in 1 case each on the seventh, eighth, fourteenth and fifteenth days. The temperature elevations ranged from $\frac{1}{2}$ to 6 degrees and lasted from 1 to 42 days. In 15 cases the temperature subsided within a week and in 5 others by the end of the second week. One patient had an elevated temperature until the forty-second day.

Of the patients with a secondary rise, 4 showed an extension of the disease in the lungs on x-ray examination. The author reports these cases in detail.

In attempting to see whether these reactions were caused primarily because the patients were tuber-

culous, the author studied the records of 67 patients with bronchiectasis, asthma, pulmonary malignancies, lung abscess or chronic bronchitis. A total of 116 bronchoscopies was done on this group and 37 showed temperature rises in the first week—32 of which occurred during the first 72 hours. This rise ranged from $\frac{1}{2}$ degree to 4 degrees. In 36 cases, the temperature returned to normal in 1 week and in only 2 of these was there a secondary rise in temperature.

The initial rise in temperature in a majority of instances is due to the trauma of instrumentation as evidenced by the similarity of the reactions in tuberculous and nontuberculous patients. The secondary rise in tuberculous patients is an important sign and appears to indicate a spread or activation of the disease. In the nontuberculous patients the secondary rise can be attributed to reactivation of the infection or to a secondary infection resulting from the instrumentation.

In order to prevent the further occurrence of these reactions, the author suggests a more careful selection of patients for bronchoscopy, a minimum of trauma during instrumentation and encouraging the patients to clear the tracheobronchial tree of secretions as soon as possible. Many believe that the disturbance of the cough reflex may be associated with the febrile response and extension of tuberculous disease. The author thinks that the minimum quantity of anesthetic necessary should always be used in order to disturb the cough reflex as little as possible.

ROBERT R. BROWNE, M.D.

sufficient reward. If the closure of the perforation causes too great a narrowing of the duodenum the addition of a gastroenterostomy is needed but other arguments in its favor such as relief from future ulcer symptoms, earlier feeding and obviating of future operation, seem unsound. The same probably holds true for excision and pyloroplasty. The patients on whom gastroenterostomy was done lived.

In many reports, gastric resection has shown the lowest mortality. Nevertheless, it is doubtful that this operation should ordinarily be given serious consideration. Gastrectomy is a highly technical operation which is not applicable for the average case treated under emergency conditions by the average emergency staff.

In conclusion the authors state that

1. It should be possible to lower our mortality. High mortality may be due to relative unfamiliarity with the surgical technique, to a delay in surgery until peritoneal infection has set in, or to a mistake in diagnosis resulting in the wrong approach with a consequent longer and less accurate operation. Leaving out age and other angles beyond our control, the time elapsing between perforation and operation is the most important factor affecting the results of the individual operator.

2. A correct diagnosis can usually be made as the clinical features are so striking as to make it apparent that a surgical emergency exists. In the great majority free air in the abdominal cavity can be shown by x ray if one wishes additional support.

3. While radical resection may have its place in selected cases in the best surgical clinics, the routine treatment should be the earliest possible and the simplest thorough closure with the best supportive preoperative and postoperative treatment.

4. Recurrence of ulcer symptoms will take place in the majority of patients. In the event of ulcer recurrence the proper medical treatment can be outlined and if surgery becomes necessary the best operation for the condition can be chosen after due deliberation and study and after proper preparation.

CHARLES BARON, M.D.

Urdondo, C. B. and Naslo, J.: The Incidence of Gastric and Duodenal Ulcer in Different Professions and Occupations (Incidenencia de la úlcera gástrica y duodenal en las profesiones y oficios). *P. curs. méd. argen.* 945, 32 38.

The authors have made a careful study of the profession or occupation of 2 557 patients with gastric and duodenal ulcers and give tables showing the details of their findings. These ulcers are more frequent among professional people than among physical workers and among all the professional people they are most frequent in public officials, probably because of the psychic demands made on them. A study of the cases in physical workers, in whom ulcers are less frequent than in psychic and intellectual workers, shows that gastric and duodenal ulcers are not caused by repeated microtrauma of the epigastric region as has frequently been claimed.

Among the professional people with ulcer there are many more male than female patients. The localization of the ulcer is related to a certain extent to the patient's occupation, duodenal ulcer being more frequent in professional people and gastric ulcer in workmen. Domestic work is classified as psychophysical and most of the patients in this group are women. They show a predominance of gastric ulcer.

A bad course of the ulcer is more frequent in professional workers than in workers of the physical and psychophysical groups. This also tends to disprove the theory that violence is involved in the causation of ulcer. A bad course does not seem to be related to sex or localization of the ulcer.

Recurrences were more frequent after one operation in the physical workers and after two operations in the professional workers. Among the few cases in which three operations were performed there were more physical workers with recurrences.

A hyperacid type of gastric secretion predominated in the physical workers, a normal acid curve in the psychic workers, and hypoacid or normal acid curve in the psychophysical groups. About 30 per cent of the patients showed some habit tending to cause alimentary intoxication, such as the use of tobacco, alcohol, mate, or coffee. The use of alcohol or tobacco was more frequent among the physical workers and of coffee among the psychic workers. The use of tobacco or mate did not seem to have any special tendency to cause ulcers.

AUGUST G. MORROW, M.D.

Dalley M. E., and Miller E. R.: A Search for Symptomatic Gastric Cancer in 500 Apparently Healthy Men of 45 and Over. *Gastroenterology* 1945 5 1.

The authors, in an attempt to discover minor (early) gastric malignancies, examined 500 normal men by a barium meal examination, the rationale being precisely that of a mass chest survey. All subjects were 40 years or over and were free of digestive complaints. All were examined by the barium meal procedure and fluoroscopy. A full gastrointestinal series was performed whenever a hint of abnormality was present.

The findings revealed that 3 men of 500 appeared to have persistent gastric lesions—one had a gastric ulcer, another a suspected antral polyp and the third had antral gastritis—the last being verified by resection.

While the authors' work was in progress, St. John Swenson and Harvey uncovered 3 gastric malignancies among 2,413 men and women. However the individuals in their survey were not necessarily asymptomatic. Rigler at the same time discovered in routine x-ray examination of the stomach 21 gastric cancers and 15 polyps among 217 patients with pernicious anemia.

The authors conclude that a survey of the general population in search of gastric cancer is not worthwhile but that studies of selected groups such as

persons with pernicious anemia should be expanded. On the other hand the rigid selection of candidates excluded individuals with the slightest symptoms and thus the results in no way detract from the view that even mild dyspepsia in older individuals demands a prompt and adequate investigation.

DOUGLAS R. MORTON M D

Waugh J M and Fahland T R: Total Gastrectomy. *Surg Clin. A. America*, 1945 35 903

In 77 cases of total gastrectomy by the abdominal route performed at the Mayo Clinic from 1917 to 1943 inclusive, the over-all surgical mortality rate was 44.3 per cent. The mortality rate for the 33 cases in which operation was performed between 1917 and 1939 inclusive was 60.6 per cent as compared with the mortality rate of 3.18 per cent for the 44 cases in which operation was performed between 1940 and 1943, inclusive. Gastrectomy was performed in 1943 in 20 cases with 5 deaths a mortality rate of 25 per cent.

Waugh and Fahland attribute the remarkable reduction of surgical mortality in this series to the increased experience of the surgeons in dealing with the procedure, improvements in postoperative care, the use of chemotherapy, and the early recognition and rigorous treatment of postoperative complications.

More than half of the patients who survived the operation of total gastrectomy for cancer lived 2 or more years whereas 2 patients who underwent total gastrectomy for benign lesions have lived 6 and 8 years respectively and are still alive as far as can be ascertained.

STEPHEN A. ZERMAN M D

Isaacs, A. H. Intussusception in Adults. *Surgery* 1945 18 457

Statistical data appear to show that of all intussusceptions, the incidence in adults is about 5 per cent. It is common medical experience that in infants there are, as a rule, no discoverable etiological factors, while in adults there is usually an organic lesion, a benign or malignant tumor as the basic cause. Other provocative influences are (1) typhoid ulcers (2) tuberculous ulcers, (3) dysentery (4) acute appendicitis (5) Meckel's diverticulum (6) a congenital ileal band (7) a submucous lipoma of the ileum (8) a foreign body (9) a sudden radical dietary change or (10) neoplasms.

Enlarged lymphoid patches not infrequently cause intussusception, and an instance in point appears to be the high incidence of the ileocecal variety with the presence of large Peyer's patches. The detrusor action of the terminal ileum and the greater size of the colon have been regarded as other probable causes.

The majority of intussusceptions are of the enterocolic variety and it is in the ileocecal zone that considerable anatomic alteration in the size of the gut takes place.

Fraser proved that the innervation of the ileocecal zone is distinctive in that the nerve supply of the ileum

is sympathetic and parasympathetic the cecum receives a supply of sympathetic nerves only. An explanation is thus found for the descending peristaltic irregularity.

Intussusception at times occurs during an attack of enteritis and there is a strong probability that the swollen Peyer's patches may induce the hyperperistalsis.

Intussusception of the gastrointestinal tract may take place anywhere between the stomach and the rectum. The large bowel is the most frequent site of involvement in adults because benign and malignant growths particularly the former are more common there than in any other part of the gastrointestinal tract.

An intussusception usually forms a rather firm sausage-shaped swelling composed of three concentrically arranged tubes or layers—the afferent, efferent, and encasing. The first two form the intussusceptum and meet at the apex or most distal part of the invagination. The encasing layer constitutes the intussusciplens and joins the returning layer at the neck of the intussusception.

Intussusception may be single or compound. In the latter the primary invagination is surrounded by a secondary one which may in turn be surrounded by a tertiary.

Three forms of intussusception may be distinguished:

1 Enteric (10 to 15 per cent) in which the small intestine invaginates is prevalent in older children and adults. It is usually of organic causation. In the ileocolic variety only the small intestine is involved it may progress to become an ileocolic variety ordinarily discoverable in children.

2 Colic (5 to 10 per cent) in which the colon encases (therefore, colocolic). This variety occurs in elderly persons. A not infrequent cause is a polypoid carcinoma or a benign polypoid growth.

3 Enterocolic (75 to 80 per cent) in which the ileum invaginates into the colon. This is common in infants.

When a gastroenterostomy has both an afferent and efferent jejunal loop the following three varieties of jejunojejunal intussusception may on rare occasions occur as complications within a few days or years after the anastomosis: (1) the afferent loop solely may intussuscept into the stomach (2) the efferent loop may retrograde and stop short of or pass through the gastroenterostomy stoma and (3) the afferent and efferent loops may intussuscept into the stomach.

In adults the symptoms of intussusception are not as prominent as in infants. They are vague in most instances, with signs of mild recurrent obstructions associated with symptoms of the provoking cause. There are colicky abdominal pains, nausea, vomiting, obstipation, and bloody stools. A mass in the abdomen is commonly not palpable. In jejunal intussusception symptoms, usually intermittent may be present for months or years. There is always a history of upper abdominal pain, especially after

meals. Nausea and vomiting are common. Blood in the stools is not as common in jejunal intussusception. The abdomen is not distended early but becomes manifestly so as the obstruction progresses. On auscultation exaggerated peristaltic sounds may be heard until there is complete obstruction when one elicits the significant silent abdomen. A tumor mass may be felt, with or without anesthesia. It is sausage-shaped and lies transversely across and subjacent to the abdominal wall.

The diagnosis is mainly roentgenographic or surgical.

If in a patient with a gastroenterostomy the afferent loop is intussuscepted the patient will as a rule complain of (1) postprandial epigastric pain with colicky exacerbations and (2) bilious vomiting. The roentgenograms in most instances will reveal a distended afferent loop. The opaque meal will demonstrate a rounded filling defect in the stomach (due to the intussusception) upon which a relief pattern, the jejunal plicae, will be observable. If the efferent loop takes a retrograde intussusceptal course an acute high small bowel obstruction results with consequent colicky abdominal pain and the vomiting of gastric, then bilious, and finally intestinal contents. If the afferent and efferent loops intussuscept into the stomach, an acute, high obstruction obviously results.

The differential diagnosis in intussusception must be made from (1) Henoch's purpura, (2) acute enterocolitis, (3) simple colic, and (4) tuberculous mesenteric glands.

The barium enema and examination of the abdomen without opaque media are used to diagnose intussusception. In subacute and chronic intussusception in adults, it will be found that the combined contrast meal and enema examination will prove most helpful in diagnosis.

Palliative treatment is justifiable only under the most exceptional circumstances. An early intussusception can sometimes be completely reduced with a pressure enema of water or air. This method is dangerous and is better employed in infants and older children. In early cases a barium enema may be given at low pressure and an attempt should be made to reduce the mass under fluoroscopic control. This is often surprisingly successful in the colic or enterocolic varieties. It is almost impossible to reduce the enteric variety merely by rectal injection.

As a rule, an immediate surgical operation should be performed as soon as the diagnosis is made. Either anesthesia is best avoided. Spinal anesthesia is preferred. A one-stage operation may be performed. When a hot pack fails to effect reduction an attempt should be made to insert a finger into the neck of the intussusception (between the entering and returning layers) and to sweep it around in this space. The adhesions are thus broken down and reduction facilitated. If this maneuver proves ineffective a rubber-covered forceps is placed in the neck as far as is safely possible and the blades are opened in several places. This procedure serves the dual purpose of

dilatating the neck and of breaking down recent adhesions. If the aforementioned methods fail, the neck should be divided for an inch or more along the antimesenteric border with a pair of forceps. The incision is closed transversely to avoid narrowing of the lumen of the gut.

If the large intestine is the intussusception site, graded operations are preferable. In some cases of irreducible uncomplicated intussusception a short circuiting operation may be performed. If the intestine is irreducible and gangrenous, one of the following expedients may be tried: (1) resection, with end-to-end, side-to-side, or end-to-side anastomosis, (2) Jescot's operation—removal solely of the invaginated part of the bowel through the encompassing part of the intestine. After the incision in the bowel is made, the invaginated part is withdrawn in a downward direction as far as possible and cut away. Circular suturing closes the cut margins of the amputated, gangrenous bowel. The caesarean part of the bowel is then approximated and united by a through-and-through continuous suture whereon a Lambert stitch is placed. Finally a few interrupted sutures close the neck of the intussusception.

The treatment of jejuno gastric intussusception is always surgical. If the afferent loop is involved, reduction is affected by slight traction. A recurrence is prevented either by anchoring the afferent loop to the stomach or to the transverse mesocolon or by undoing the gastroenterostomy. Sometimes a gastrectomy in part, including resection of the anastomosis, may be deemed advisable. If the efferent loop is entangled reduction by traction may be found adequate, but in delayed cases, with gangrene, resection must be carried out. When both intestinal loops are involved, reduction is by traction.

JOSEPH K. NARAY, M.D.

Segal, H. L., Scott, W. J. M., and Watson, J. S.: Massive Hemorrhage from the Small Intestine. *J. Am. Med. Ass.* 945, 29, 6.

As a result of the analysis of the authors' cases and of those reported in the literature the following suggestions are given to help differentiate massive gastrointestinal hemorrhage due to lesions of the jejunum and ileum from that due to gastroduodenal ulcers.

1. One should be aware that small intestinal lesions may produce this syndrome.
2. The pains present are not quite as typical as those of peptic ulcer.
3. Hematemesis is usually not present.
4. The gastrointestinal series is negative for a definite ulcer although it may be suggestive of duodenal irritability or pyloric spasm.
5. A roentgenological study should be made of the small loop for retained barium.
6. A Levine tube passed during the episode of melena will not reveal gross blood. (This is done after the barium meal has ruled out a gastric or esophageal lesion.)

7 A gastric analysis may show low values for hydrochloric acid.

8 The presence of a palpable mass which slides away from the fingers may suggest a lesion of the small intestine.

9 Small intestinal lesions may be present in addition to a peptic ulcer.

The possibility of a small intestinal lesion should be considered in any patient who has repeated or continuous melena in the absence of hematemesis and in whom the pains seem somewhat atypical for peptic ulcer. Such patients should have diagnostic studies even during the active phase to help determine whether the bleeding is from the common source peptic ulcer or from the uncommon origin in the small intestine. **JOHN J. MALONEY, M.D.**

Shallow, T. A., Eger, S. A., and Carty, J. B.: Primary Malignant Disease of the Small Intestine. *Am. J. Surg.* 1945 60 172.

Primary malignancy of the small bowel is a rare condition, which is difficult to diagnose early. The treatment of this condition requires extensive operative technique and results in a high operative mortality and grave prognosis. Since this is a challenge to the modern surgeon, the author reviews 38 consecutive cases of histologically proved small-bowel malignancy encountered in the Jefferson Medical College Hospital, Philadelphia.

Primary small intestine malignancy occurs in 0.2 per cent of all autopsies, while large-bowel malignancies are 36 times as frequent. Three per cent of all intestinal carcinomas and 60 per cent of all intestinal sarcomas occur in the small bowel. Each division of the small bowel is involved equally by malignancies, carcinoma being twice as frequent as sarcoma, however the frequency in the ileum is lowest for carcinoma and highest for sarcoma. Eger reports that of 305 duodenal carcinomas 62 per cent involved the second portion, 24 per cent the first, and 12 per cent the third, 2 per cent involved the entire duodenum. Small-intestine carcinoids comprise 0.03 per cent of the autopsy and surgical specimens (8.3% of all small intestine neoplasms). They occur chiefly in the ileum.

Small-intestine neoplasms are grossly classed in order of frequency as stenosing infiltrating or ulcerating and polypoid. Sarcomas extend toward the mesentery without producing obstruction or hemorrhage in contradistinction to carcinoma. Carcinoids are small firm submucosal yellow nodules which rarely obstruct, but grow slowly and metastasize to regional nodes in 25 per cent of the cases rarely to the liver. Thirty-one of the 38 cases showed metastases and extension to the regional nodes and liver. In 5 of the 7 cases of duodenal carcinoma there were widespread metastases; in 1 case there was regional node involvement and in 1 case there were no metastases. Of the 7 ampullary lesions 5 showed metastasis but in only 1 was the pancreas involved. Of the 14 jejunal and ileal malignancies 4 were without metastases, 9 had regional involvement, and 11

had widespread metastases. No malignant carcinoids were found.

The early diagnosis of primary malignancy of the small intestine depends on careful evaluation of the history and the physical laboratory and x-ray findings. The onset of symptoms was insidious in most of the cases although occasionally it was sudden with perforation, severe hemorrhage or intestinal obstruction. The duration of symptoms varied from 5 days to 7 days and averaged 7 months. Ampullary lesions produced biliary obstruction before intestinal obstruction, the occasional intermittency of the jaundice being due to tumor slough, increased intra-biliary tension which forced bile through the point of obstruction or subsidence of papillary edema. Over 75% of the small intestine neoplasms were palpable, fixed if duodenal and mobile if jejunal or ileal. Laboratory studies aid in diagnosis and guide the preoperative and postoperative management. Seventeen of 29 cases gave x-ray demonstration of the lesion. Vomiting caused several examinations to be unsuccessful. Eight neoplasms failed to visualize on x-ray even though the duration of symptoms averaged 14 months. In spite of this x-ray study seems to offer the best aid to diagnosis of these lesions at the present time.

Decompression of the intestinal tract and maximum improvement medically are essential preoperatively. This is accomplished by correcting any fluid and electrolyte imbalance, anemia, vitamin and plasma protein deficiency and impaired function of the heart, liver and kidneys. The type of operation depends on the patient's condition, the location and extent of the growth and the presence or absence of complications such as jaundice or metastases. Ideally early and adequate resection of the growth and the adjacent mesentery with re-establishment of bowel continuity is the treatment of choice.

Various operations were carried out. One duodenal malignancy was resected. It was located in the third portion, and a side-to-side duodenojejunosomy was carried out, the second portion of the jejunum just distal to the ampulla being anastomosed to the jejunum 10 inches from the ligament of Treitz. The patient was alive and well 10 months later.

In the ampullary group the bile was redirected to the gastrointestinal tract in all cases. Resection was contemplated in 2 cases without metastases but the patients failed to survive the first stage. All the jejunal lesions were resected and end-to-end anastomoses done. One case because of a contact carcinomatous fistula required a resection of the terminal ileum with an end-to-side anastomosis with the ascending colon. This case was reported in some detail by the author and 3½ months postoperatively showed normal x-ray studies of the small intestine and colon. One patient with a sarcoma invading the transverse colon is alive 12 years later. This was resected and anastomosed primarily. Another patient with sarcoma of the jejunum died of metastases fifteen years after the primary operation. Six

ileal malignant tumors were resected and 1 tumor was exteriorized, 3 which were considered nonresectable were treated with x ray therapy. Of the patients who underwent resection, 1 with lymphosarcoma is well 7 years later and the 3 others who survived operation could not be traced.

These surgical results compare unfavorably with large intestine malignancies. Since these lesions are difficult to diagnose and metastasize early, they are usually beyond the curable state at operation. The sarcomas have a better prognosis than carcinomas. The author believes that primary malignancy is most amenable to treatment if it is jejunal and least amenable if duodenal. The author treated 27 of his 38 cases surgically with a 43 per cent operative mortality. Four of the patients are living and well, 12 7 and 4 years and 10 months respectively after operation. Four others lived 5 4 and 3 years, and 1 year respectively. Sixteen survived 6 months or less, 3 were lost to follow up and 11 expired without surgery. The most common causes of death were metastases and circulatory failure.

ROBERT R. BIDDLE, M.D.

Kiefer, R. D. and Ross, J. R.: Chronic Ileitis. *J Am Med Ass* 945 39 94.

On the basis of the experience reported here with the treatment of 103 cases of chronic ulcerative enteritis, conservative management is indicated in the early acute forms of the disease. In mild cases of chronic uncomplicated terminal ileitis and in uncomplicated segmental enteritis with extensive involvement of the jejunum and ileum.

As a general rule, chronic terminal ileitis is best treated surgically. This is in agreement with the conclusions of Ginsburg and Garlock. When the enteritis is complicated by obstruction, fistulas or abscesses, surgical measures are definitely the treatment of choice.

Although surgery is not successful in all cases, the resection of the inflamed loops of intestine produces a high percentage of satisfactory results. Another point favoring surgical measures is the low operative mortality.

JOHN J. MALONEY, M.D.

Gatewood, J. W.: Solitary Diverticulitis of the Cecum. *Ann Surg* 945 57.

The difficulty of differentiating acute appendicitis preoperatively and carcinoma at operation, from the usual findings in the case of an inflamed cecal diverticulum makes a consideration of this subject of prime importance. The most common preoperative diagnosis made in cases of solitary diverticulitis of the cecum is appendicitis, while in many cases at operation, radical resections are carried out on a presumptive diagnosis of carcinoma. The possibility of solitary diverticulitis of the cecum should always be considered on examination of a patient who has had a previous appendectomy and who complains of right lower quadrant pain. When operating for appendicitis and finding an apparently normal appendix, one should make a careful search

for cecal diverticulitis. Two cases of solitary diverticulitis of the cecum occurring in young males are reported.

In most cases of solitary diverticulitis of the cecum, local excision is all that is required to effect a permanent cure. This is in contradistinction to multiple diverticulitis for which most treatment is palliative. As pointed out by Jones very large, inflamed diverticula lying close to the ileocecal valve, or between the leaves of the mesentery so as to jeopardize the cecal blood supply, require extensive resection. In the 3 cases reported one of the most distinguishing features at operation was the normal condition of the bowel surrounding the inflamed diverticulum, which made firm closure easy after local excision of the diverticulum. Associated appendectomy with local excision of the diverticulum is justified and does not increase the risk appreciably. In 1 of the cases microscopic examination of the appendix revealed a diffuse inflammatory process which might have caused trouble if it had been allowed to remain.

JOHN L. LINCOLN, M.D.

Dennis, C.: Ileostomy and Colectomy in Chronic Ulcerative Colitis. *Surgery* 945 8 435.

It has been found that with prompt and proper surgical management, chronic ulcerative colitis is not a disabling disease. Surgical management is recommended for all cases of nonspecific ulcerative colitis except the very mild ones that can usually be handled medically. The emergency indications for surgery are uncontrollable hemorrhage, fulminating disease, impending perforation, and obstruction. Four elective indications for surgery are recognized, cases that resist all forms of medical treatment, segmental ulcerative colitis, very early ulcerative colitis and polyposis including the cases with possible malignancy. From the satisfactory results obtained, and until the true nature of the disease shall have been discovered, surgery appears to offer the best hope to the patient.

During 16 recent months at the University of Minnesota Hospitals, Minneapolis, 23 cases of ulcerative colitis were observed, 16 were given the benefit of surgery and of the 7 not undergoing operation, 2 died, 2 improved, and 3 failed to improve.

The author stresses the fact that extreme thoroughness and precision in every detail of the preoperative, operative and postoperative care are the important factors that have made surgery for chronic ulcerative colitis a success at the University of Minnesota Hospitals. The procedures used to minimize the risk of surgery and to avoid the most complications that have made ileostomy objectionable are excellently described in full detail.

After careful preoperative preparation, ileostomy is the initial surgical procedure and should not be complicated by any other simultaneous procedure. A method of ileostomy which minimizes the complications of herniation, fecal fistula and prolapse is described. With meticulous postoperative care

excoriation and breakdown of the skin have been negligible.

The success of meticulous management of these patients is emphasized by the fact that in 20 cases there were 1 case of prolapse, 2 cases of recession, 2 cases of some trouble with skin excoriation, no cases of failure of primary union, no hernias and 3 deaths. The deaths occurred from pulmonary embolus in one case and from involvement of the ileum, jejunum, and stomach in the other. Colectomy is not done until from 4 to 6 months after the ileostomy and except in selected cases then only for repeated exacerbations of colitis, polyps or carcinoma of the colon, profuse drainage or continued bleeding.

The rectum is spared in removing the colon and an improved method of closing the rectal stump is described. In some cases it was possible to re-establish the continuity of the bowel by ileoproctostomy many months after the ileostomy.

DAVID H. LYNN, M.D.

Rubenstein, A. D. and Johnson, B. B.: Salmonella Appendicitis. *Am J M Sc.* 1945 210 517

It is probable that a significant reservoir of salmonella infection exists among the general population.

The authors studied 811 cases of salmonella infection, 20 of these (approximately 2.5%) developed signs and symptoms of acute appendicitis, and 18 came to operation. All of the cases in which the symptoms of appendicitis occurred were in children or young adults. The difficulty of the differential diagnosis in cases in which these maladies are associated is stressed.

Of the 18 cases which came to operation, 11 showed no acute inflammation while 7 were found to have acute, subacute, or gangrenous appendicitis. It is assumed that lymphoid hyperplasia of the small intestine, appendix, or mesenteric nodes was responsible for the acute abdominal manifestations.

The authors suggest that an underlying salmonella infection should be suspected in instances of unexplained persistent postappendectomy fever. They further point out that the recognition of the basic etiology in cases of salmonella appendicitis will aid in the prevention of secondary infections among contacts in the hospital and at home.

DAVID H. LYNN, M.D.

Hoerr, B. O.: Mortality Factors in Acute Appendicitis. *Surgery* 1945 18 303

The failure of improvement in the mortality figures for patients with acute appendicitis at the Peter Bent Brigham Hospital, Boston, Massachusetts, from 1913 through 1940 stimulated a detailed study of the 106 fatalities during this period. Attention was focused on the 80 operative cases in which death was directly attributable to progressing appendicitis or its specific complications.

Delay in operation was shown to be the major factor in fatal cases. Sixty-seven of the 80 patients

were operated on 48 hours or more after the initial symptom. Fifty-eight patients were operated on within 6 hours after reaching the hospital, but hospital delay of more than 6 hours occurred in 16 cases because of the uncertainty of the diagnosis. It is suggested that operation be performed promptly when the differential diagnosis lies between acute appendicitis and some other condition, such as acute salpingitis, in which operation is not definitely contraindicated. The consequences of delay are reflected in the fact that at the time of operation 53 patients had acute perforated appendicitis, 14 had appendiceal abscess, and only 13 had acute unruptured appendicitis. There were only 6 fatalities in the cases of patients who were operated on within 30 hours of onset of the condition. Of these, 5 had perforated appendicitis. It must be noted that 49 of the 80 patients had definitely received cathartics.

Fifteen patients had undrained residual abscesses at the time of death. The author states that such abscesses should be especially sought for in cases not improving after a period of 2 weeks from the onset of the disease. Ten patients died of severe ileus or mechanical intestinal obstruction, prompt preventive measures or timely operative intervention might have saved some of them. Three patients died despite adequate dosages with sulfonamides.

Statistics based upon the 80 cases give a slight advantage for the McBurney incision. Statistics, likewise, vindicate the trend in recent years toward closure without drainage, even in selected cases with perforation.

SAMUEL KAHN, M.D.

Hurt, L. E.: The Surgical Management of Colon and Rectal Injuries in the Forward Areas. *Ann Surg* 1945 122 392.

Initial surgery of 39 injuries of the colon and rectum was performed by a general surgical team of an auxiliary surgical group functioning with the Fifth Army in Italy. Most of the injuries were caused by fragments. Twenty-nine patients were operated upon within 12 hours of injury, 3 within 6 hours. A short time interval can contribute toward an increased mortality because more of the severely wounded come to surgery. The average time interval was 15 hours. The contribution of shock toward an increased mortality was exemplified by 5 deaths in spite of vigorous replacement therapy among 8 patients admitted in severe shock. The second part of the duodenum was injured in 2 of 4 cases of injury of the hepatic flexure. Peritoneal contamination and early infection responded gratifyingly to forward surgery and its adjuncts, sulfonamides and penicillin for only 12 patients exhibited objective signs of peritonitis. Eight patients sustaining injuries of the colon or rectum above were treated successfully. Thirteen with colon injuries complicated by severe concomitant wounds died a mortality rate of 33 per cent. Severe shock, secondary to injuries of the colon complicated by concomitant wounds, was the dominant cause of death. Next to shock, sepsis was the leading cause of death.

For obvious reasons primary suture of the unprepared colon in the presence of peritoneal contamination has always been condemned in the author's theater. Consequently all initial operations were designed to divert the fecal current outside the peritoneum. The only exception to this rule has been in those patients sustaining injury between the sigmoid and the extraperitoneal rectum. These perforations were closed by suture and supplemented by proximal colostomy. The type and severity of the injury occurring between the terminal ileum and sigmoid colon usually determined whether a loop or double-barrelled colostomy with spur was to be performed. Single or closely associated multiple anterior and lateral wall perforations and antimesenteric hemisections were exteriorized as loop colostomies. Mesenteric hemisections, transections, and extensive injuries necessitating resection of the colon were exteriorized as a double-barrelled colostomy with spur. In an endeavor to perform an initial operation that not only diverted the fecal current extraperitoneally but also left the patient with a simple stoma which could be closed secondarily without entrance into the peritoneal cavity. Since the extraperitoneal closure of a loop colostomy of the right colon is impractical, a single perforation of the right colon was treated by tube colostomy or cecostomy.

Injuries of the splenic flexure and left half of the transverse colon complicated by those of the left diaphragm and left lung caused by a single missile, were operated upon transdiaphragmatically. Some of the advantages of a thoracic operative approach in thoracoabdominal wounds on the left side were excellent visualization of the wound tract, easy removal of the frequently fragmented spleen, mobilization of the splenic flexure under direct vision, and elimination of the separate celiotomy incision, with its subsequent pain, which permitted the institution of an intensive cough routine so necessary for the postoperative intrapleural injury.

Before closure of the diaphragm the injured segment of the splenic flexure or transverse colon was exteriorized either as a loop or double-barrelled colostomy with spur through a stab incision in the left upper quadrant of the abdomen. Likewise, if drainage of the abdomen was desired the drains were brought out through another but smaller stab incision of the left abdominal wall. On the other hand, injury of the hepatic flexure complicated by injuries of the liver, right diaphragm, and right lung and caused by a single missile necessitated thoracotomy and a separate celiotomy incision as the liver offers complete obstruction to exploration of the right abdomen.

The initial surgery of extraperitoneal perforations of the rectum consisted of thorough debridement of the wound tract, suture of perforations, and sigmoid colostomy. In addition, resection of the coccyx and incision of the fascia propria were done to insure adequate drainage of the retroperitoneal, posterior and pararectal spaces. All sigmoid colostomies were of the loop type. However a recent personal com-

munication with surgeons in Base Hospitals has revealed that loop colostomy for rectal injuries has failed in many instances, to divert completely the fecal current. Consequently patients with rectal injuries have arrived at the Base from the Forward Area Hospitals with fecally contaminated buttock wounds and the rectum filled with feces. In the future it is proposed to transect the sigmoid and prepare a spur at the time of initial operation of all extraperitoneal rectal injuries.

Colcock has reported from a hospital in the Zone of Communication that osteomyelitis of the sacrum has been a frequent complication of coccygectomy in those with rectal wounds. Because of this, posterior drainage is now being accomplished without resection of the coccyx. It is the feeling of most of the surgeons in this theater that adequate drainage can be ensured through a curved incision inferior to the coccyx, incision of the fascia propria, and opening of the posterior and pararectal spaces by blunt dissection.

JOHN E. KIRKPATRICK, M.D.

Croce E. J. The Management of War Injuries of the Extraperitoneal Rectum. *A. & S. Surg.* 215, 408.

Injuries of the rectum present many problems which are peculiar to it alone. These problems arise largely from its physiological and anatomic properties. As the organ of temporary storage and evacuation of the solid wastes of the intestinal tract, its contents teem with organisms, many of them potential pathogens, both aerobic and anaerobic. Anatomically it is for the most part unprotected by infection resisting peritoneum. It traverses a tissue which is highly vulnerable to infection, and it is difficult of surgical access. In order to understand more fully the implications of the anatomic problems, the essential details of the relationships of the rectum are reviewed.

The clinical syndrome of retroperitoneal abscess was a nightmare to the surgeons of World War I. Drummond reviewed the problem at the close of World War I. His suggestions as to treatment reveal that the problem at that time was still very much in the experimental stage, although some of his suggestions have proved extremely practical.

In extraperitoneal wounds of the rectum the only hope of success lies in very free local drainage carried out at the earliest possible moment. With a view to establishing efficient drainage he removed the uninjured coccyx in a cases, and in addition arranged for free drainage of the wounds of entry and exit. He found by stripping up the bowel that he was able to expose the wound in the rectum and was thus enabled to drain and pack off the surrounding parts and prevent further tracking by retroperitoneal hemorrhage.

During the past 3 years the authors were fortunate enough to administer definitive treatment to a moderate number of patients returning from the battlefields in various stages of convalescence from war wounds of the rectum, and in addition, were able to

evaluate the treatment of many others who had not remained under their care. From these observations it was believed that progress has been made during this war in the management of extraperitoneal injuries of the rectum and that it warranted the crystallization of surgical management. The part played by surgical prophylaxis in contrast to the supportive measures of blood plasma, and chemotherapeutic agents is emphasized. When the latter are applied alone without surgery they may influence the early mortality rate in assisting recovery from shock, but they do not appreciably alter the morbidity or late mortality rate from chronic sepsis. These measures have been proved to be merely adjuncts and not in any way substitutes for early and properly executed surgery.

The following conclusions as a result of observations have been reached:

1. Perforation of the intraperitoneal portion of the rectum results in fecal contamination of the cellular tissue of the intraperitoneal space. This space communicates with the retroperitoneal space posteriorly over the sacrum and this may result in full unloading and widespread sepsis behind the peritoneum.

2. Even when the perforation cannot be located but there is presumptive evidence of its presence or potential development from contusion or infarct of the rectum as judged from the course of the missile and the presence of a large hematoma in the intraperitoneal space, an effective sigmoid colostomy should be established at once.

3. A sigmoid colostomy alone will not prevent infection of the intraperitoneal space although the infection is likely to be less widespread and fulminating after contact with the normal intraluminal pressure is severed and gross contamination of the normally functioning bowel is avoided. In addition, the intraperitoneal perirectal space must be ascertained by coccygectomy and loosely packed.

4. Mere sacralization of the perirectal space while life-saving and prophylactic against spreading retroperitoneal sepsis is not however complete ideal treatment. Unless the perforation is located and closed a persistent fistula may develop.

JOHN E. KIRKPATRICK, M.D.

Dixon, C. F. and Benson, R. E. Carcinoma of the Sigmoid and Rectosigmoid Involving the Urinary Bladder. *Surgery* 1945 18 191

At present carcinoma of the sigmoid and rectosigmoid with distant metastasis is amenable only to palliative treatment. However when local extension of the disease only is present the condition is seldom inoperable. It therefore seemed advisable to the authors to point out some of the problems associated with carcinoma of the sigmoid and rectosigmoid involving the urinary bladder and to review their experiences with its surgical management. This study is based on 64 consecutive cases in which operation was performed by the senior author in the years 1931 to 1943 inclusive.

A small amount of secondary invasion of the urinary bladder by carcinoma of the sigmoid or rectosigmoid may give rise to no clinical or laboratory findings. More extensive involvement often produces distressing urinary symptoms and pyuria.

Of the 64 patients in the present series, 59 were males and 5 were females. The apparent infrequency of involvement of the urinary bladder in this condition in the female in comparison with the male is evidently attributable to anatomic differences in the pelvis. The ages of the 64 patients varied from 39 to 76 years the average age being 55 years. In the majority of cases carcinoma had been present for a long time and it is therefore not surprising that many patients were in poor general condition.

Probably the first step in invasion of the urinary bladder by carcinoma of the sigmoid or rectosigmoid is an inflammatory attachment of the tumor to the peritoneal covering of the bladder. This situation sometimes is encountered at operation. In such a case the malignant process can be dissected from the urinary bladder without an opening into its lumen. The examination of small bits of tissue from the vesical wall at the site of attachment will reveal the presence or absence of residual carcinoma and will allay any doubt in the surgeon's mind as to whether the malignant process has been completely eradicated. The inflammatory reaction around a secondary malignant growth of the bladder is a phenomenon not only of the early stages but also of the later stages of the malignant disease. Often advanced carcinoma that has extensively infiltrated the wall of the bladder is surrounded by such a severe inflammatory reaction that it is difficult to determine even at operation when the lesion is in full view and can be examined by the palpating hand whether the reaction is primarily inflammatory or neoplastic.

When a large carcinoma in the sigmoid or rectosigmoid has extended to the urinary bladder and is surrounded by an indurated inflammatory reaction the surgeon may be tempted to perform colostomy and to wait several weeks for the inflammation to subside before undertaking resection of the bowel. Undoubtedly this is often a valuable procedure but the senior author recently has concluded that postponement of resection after the distal segment of colon has been defunctionalized will not as a rule appreciably diminish the inflammatory reaction if the malignant growth has penetrated completely through the wall of the bladder. In such instances the urine and the diseased condition of the bladder continue to feed the infection in spite of the use of urinary antiseptics. Therefore it has become the senior author's practice to resect such lesions primarily whenever the general condition of the patient warrants the procedure.

In 45 of the 64 cases in this series the condition was classified as operable. Two patients in the group who presumably had removable lesions died after colostomy. In the remaining 40 cases resections were performed. In 19 of the 40 cases the

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Of the 64 patients in the present series 59 were males and 5 were females. The apparent infrequency of involvement of the urinary bladder in this condition in the female in comparison with the male is evidently attributable to anatomic differences in the pelvis. The ages of the 64 patients varied from 29 to 76 years, the average age being 55 years. In the majority of cases carcinoma had been present for a long time, and it is therefore not surprising that many patients were in poor general condition.

Probably the first step in invasion of the urinary bladder by carcinoma of the sigmoid or rectosigmoid is an inflammatory attachment of the tumor to the peritoneal covering of the bladder. This situation sometimes is encountered at operation. In such a case the malignant process can be dissected from the urinary bladder without an opening into its lumen. The examination of small bits of tissue from the vesical wall at the site of attachment will reveal the presence or absence of residual carcinoma and will allay any doubt in the surgeon's mind as to whether the malignant process has been completely eradicated. The inflammatory reaction around a secondary malignant growth of the bladder is a phenomenon not only of the early stages but also of the later stages of the malignant disease. Often advanced carcinoma that has extensively infiltrated the wall of the bladder is surrounded by such a severe inflammatory reaction that it is difficult to determine even at operation when the lesion is in full view and can be examined by the palpating hand whether the reaction is primarily inflammatory or neoplastic.

When a large carcinoma in the sigmoid or rectosigmoid has extended to the urinary bladder and is surrounded by an indurated inflammatory reaction, the surgeon may be tempted to perform colostomy and to wait several weeks for the inflammation to subside before undertaking resection of the bowel. Undoubtedly this is often a valuable procedure but the senior author recently has concluded that postponement of resection after the distal segment of colon has been defunctionalized will not as a rule, appreciably diminish the inflammatory reaction if the malignant growth has penetrated completely through the wall of the bladder. In such instances the urine and the diseased condition of the bladder continue to feed the infection in spite of the use of urinary antiseptics. Therefore it has become the senior author's practice to resect such lesions primarily whenever the general condition of the patient warrants the procedure.

In 43 of the 64 cases in this series the condition was classified as operable. Two patients in the group who presumably had removable lesions died after colostomy. In the remaining 40 cases resections were performed. In 19 of the 40 cases the

attachment to the bladder was of an inflammatory nature and removal of the tumor did not necessitate an opening into the lumen of the bladder. In the remaining 31 cases portions of the full thickness of the vesical wall were removed. In 15 of these approximately a third or more of the organ was resected. In 6 cases smaller segments were resected. In most of the cases resection of the bowel was completed by end-to-end anastomosis. There were 7 operative deaths. Twenty of the 40 patients were living at the time of follow-up or for more than five years after resection.

Hayden E. P.: *The Surgical Treatment of Carcinoma of the Rectum.* *N. England J. M.* 1945 833 8

Statistics on 198 cases of resection for carcinoma of the rectum are presented. In the presence of one or two metastases in the liver, or when the local growth, although extensive and perhaps abscessed, could still be removed, operation was completed in order to give relief if not cure, in this unfavorable group of patients. Of 217 patients explored only 19 presented a carcinoma so extensive that a radical procedure would have been foolhardy. One-stage abdominoperineal resection was performed in 131 cases. The other procedures carried out, in order of decreasing frequency were two-stage abdominoperineal resection, anterior resection, bilateral resection, end-to-end suture and tube resection.

A stay of from 3 to 5 days in the hospital before operation on the colon was usually an adequate period for general rest, preparation of the bowel, completion of laboratory work, and whatever measures seemed necessary to improve the patient as an operative risk. Unless contraindicated, postoperative spinal anesthesia, which greatly facilitates the ease of operation, was used. The colostomy was opened in 1 or 2 days and an enema given on the fourth or fifth day. Boric irrigations of the posterior wound were begun after removal of the posterior pack and continued until the discharge ceased. The average postoperative hospital stay of these patients was 5 weeks.

In the entire series there were 16 hospital deaths, a mortality of 13 per cent. The chief causes of death were pneumonia, sepsis, embolus and obstruction. Although over 50 per cent of the deaths occurred following one-stage resection, this should not be considered an indictment of the procedure, since actually, the number of deaths (14) was only 10 per cent of the number of single-stage resections (131), a mortality lower than that of the series as a whole. Of the 198 patients undergoing resection, 75 died later. In most cases of recurrent disease 75 of them died of unrelated causes and 96 are still alive. Of the 98 patients operated on over 5 years ago 38 or 39 per cent, have survived without evidence of disease for from 5 to 14 years. The longest interval before death occurred from recurrent disease was 3 years and 5 months after operation.

JOHN L. LINDQUIST M.D.

Mandl, F.: *The Technique and Results of the Primary and Secondary Pull Through Operations after Removal of Tumors of the Rectum and Rectosigmoid Surgery* 945, 18: 314.

Since the restoration of continence is of prime importance after the removal of tumors of the rectum and rectosigmoid, any radical operation which does not permit this possibility is regarded as imperfect. The techniques of the primary (Hochenegg) and the secondary (Weil) pull-through methods are described, the latter is accomplished by the artificial production of prolapse (Mandl) from the sacral anus and operation on the sacral hernia. The pull-through procedure may be used equally as well after sacral or abdominosacral radical operation. The method of Hochenegg holds the greatest promise of success for the restoration of continence after operations on the rectosigmoid.

Colostomy should precede the pull-through operation. Details are described. SAMUEL KARR, M.D.

LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

Ruffin, J. M., and Wise, R.: *The Value of Plasma Vitamin-A Determinations in the Differential Diagnosis of Jaundice. A Preliminary Report.* *Gastroenterology*, 945 4-466.

It has been shown repeatedly that the plasma level of vitamin A is low in liver disease. This is to be expected since it is generally agreed that carotene is converted by the liver into vitamin A. Therefore, the authors present the hypothesis that if jaundice is due to common duct obstruction *without liver damage*, one would expect a normal vitamin A level in the plasma, whereas jaundice from a diffuse hepatitis should be accompanied by a low level of vitamin A in the plasma.

In every patient in the authors' series who was classified clinically as having acute hepatitis or catarrhal jaundice, there was a significant lowering of the plasma vitamin A. Since a gradual rise in these levels coincided with clinical recovery, serial determinations of vitamin A may have definite prognostic value. There was no constant correlation between the vitamin A levels and other tests of liver function except the cephalin flocculation test, which was positive in every case.

Of the 6 patients who were found at operation to have obstruction to the common duct, 6 had no demonstrable evidence of liver involvement and had vitamin A levels which were either within or close to normal limits. The levels were definitely lowered in the remaining 4 patients, but in each case either the duration of the disease or obvious infection were factors which could readily have resulted in liver damage. Thus it would seem that a patient with common duct obstruction of short duration, without evidence of liver involvement, probably will have a normal vitamin A level, whereas if the obstruction has been prolonged, or if there is evidence of biliary tract infection or metastases to the liver, the vitamin A

level may be reduced. On the other hand patients having a diffuse hepatitis invariably will have a definite lowering of their plasma vitamin A, and it may well be that this procedure will afford valuable evidence in distinguishing between these two forms of jaundice.

FARL O. LATIMER, M.D.

Eddy, J. H. Jr: Methionine in the Treatment of Toxic Hepatitis. *Am J M Sc* 1945 310 374.

Miller and Whipple have shown that there is increased sensitivity of the liver to toxins following protein depletion in dogs exposed to chloroform. Goldschmidt, Vars, and Ravdin, in their work on mice, pointed out the protective action of protein diets. Carbohydrate as a liver protector is generally accepted and Miller and Whipple believe that its effectiveness is primarily due to its sparing the protein stores.

Lately interest has centered on the identification of the specific protein factor responsible for liver protection. Miller, Ross, and Whipple in 1940 showed that methionine and to a less extent cystine would protect the liver against injury if given before chloroform anesthesia—this protection was comparable to the feeding of a large protein meal. In 1942 they showed this same protection occurred even when the methionine was given 3 or 4 hours after chloroform anesthesia, but 6 hours after anesthesia no protection occurred presumably because all of the cells had been fatally damaged. Therefore for methionine to be of any value some viable liver tissue must be present. Clinically then early treatment is essential if methionine is to be effective. Choline alone has been shown to be useless as a protecting agent but combined with cystine it rivals methionine. Goodell, Hanson, and Hawkins in 1944 poisoned dogs with mapharsen and demonstrated the effectiveness of methionine against this hepatotoxin.

It is believed by many that methionine protects the liver from damage primarily because of its sulfur content, since protein-depleted dogs are more completely depleted of sulfur. Heppel *et al* showed that there was decreased resistance among protein-depleted animals to dichloroethane but if they were fed methionine and choline there was increased resistance to its toxic action. These dogs showed no evidence of hepatic lesions and this suggested that the protective effect of methionine may not be dependent on the liver alone. To support this theory the authors showed adrenal changes in some of their animals.

Gyorgy in 1944 stimulated clinical interest in methionine. He outlined the progression of changes in animal livers on a protein deficient diet from fatty infiltration through necrosis to cirrhosis. He pointed out the presence of ceroid in the cirrhotic livers produced by dietary means a product not seen in other forms of animal or human cirrhosis. He compares the kidney lesions simultaneously seen in cases of damaged livers on a dietary basis with the so-called hepatorenal syndrome in man. Gyorgy sug-

gested that choline and cystine are needed for the synthesis of another substance that may be methionine. He recommends its use in the prevention and treatment of hepatic injury due to purely toxic as well as dietary factors.

The author in reporting cases of carbon tetrachloride poisoning noted that the severest cases all occurred in negro women with high fat and protein deficient diets. White women with the same job and adequate diets showed only mild toxic symptoms. A case report by Beattie *et al* of treating carbon tetrachloride poisoning with methionine stimulated the author's study of its use in the treatment of hepatitis due to trinitrotoluene and later other types of hepatitis and cirrhosis.

Since July, 1944 the author has treated 30 cases of acute toxic hepatitis with methionine. Most of them were due to T.N.T. and at least 10 patients were seriously ill. To date, there have been no fatalities as compared with the published mortality of from 30 to 35 per cent in T.N.T. hepatitis. Prior to the use of methionine the author treated 3 patients with T.N.T. hepatitis, 1 of whom died and the other has a prolonged illness. Many patients seen since then have appeared to be as severely poisoned as these first cases on admission.

The average length of hospitalization of the cases treated with methionine varied from 4 days to 7 weeks and averaged 13 days. The diagnosis was based on an analysis of the occupational exposure, physical examination, icteric index and Hanger cephalin flocculation test and urinalysis for urobilinogen and bilirubin. The daily urinalysis for urobilinogen and bilirubin is of value in following the patient's course. A decrease in the bile in the urine and an increase in urobilinogen is closely followed by a decrease in the icteric index. Below 20 this decrease is slow and often a value of from 10 to 12 persists for several months. The Hanger test never gives a false negative, and false positives are rare. The author does not believe that a reading of + or ++ is significant. This reading also returns to normal slowly and may not be negative for one or two months.

Almost all patients complained of dizziness, nausea, vomiting, weakness, and pain in the right upper quadrant. On physical examination they showed jaundice and palpable enlarged livers. There has been a preponderance of white males with this condition although both colors and sexes are affected.

Treatment included bed rest, a high protein and carbohydrate diet and a low fat diet, multiple vitamin products, additional B complex vitamins and the oral administration of methionine in doses of from 3 to 5 gm daily. The average dose was from 3 to 4 gm a day but in 2 cases with more jaundice the dose was increased to 8 gm daily and the patients were fed with a duodenal tube. Both cases improved markedly after 48 hours.

The author then presents abstracts of 3 of the more severe cases of T.N.T. toxic hepatitis. Two of these cases showed such remarkable improvement after the dose was increased that the author believed

the usual dose of methionine might be inadequate and that from 6 to 8 gm. daily should be given to all seriously ill patients. The author gave 12 gm. a day to 1 seriously ill patient without evidence of toxic reactions. The usual course is to start the patient on smaller doses and increase the amount if clinical improvement is not soon apparent.

Several cases of acute carbon tetrachloride hepatitis as well as 2 cases of epidemic hepatitis all of which were treated with methionine, were improved. The treatment of some cases of cirrhosis of the liver has been started, but no conclusions cannot be drawn from the few cases in which treatment has been completed. It is apparent, however, that methionine or choline plus cystine will be of value in early cirrhosis and in controlling episodes of acute activity in older cases. Little help can be given to the far advanced cases as the functional unit has been irreparably embarrassed by the laying down of scar tissue.

ROBERT R. BROZLOW, M.D.

Blumberg, N., and Zisserman, L: Acute Suppurative and Gangrenous Cholecystitis. *Am. J. Surg.* 94:5 to 38

Much has been written about acute cholecystitis. Experimental work suggests that the pathology is usually a mechanical obstruction of the cystic duct with edema and ischemia of the wall, followed by secondary infection. The question of immediate or delayed surgery in acute cholecystitis has long been controversial. Each policy has some disadvantages; the former commits the surgeon to operate in a septic edematous field and the latter submits the patient to the dangers of a lesion that may be progressive. Acute cholecystitis can resolve itself spontaneously without surgical interference or it may progress and terminate in gangrene or empyema. The authors present this article as a study of advanced gall bladder disease—empyema and/or gangrene with or without perforation.

A series of 82 cases were examined in the period from 1929 to 1944 at the Philadelphia Jewish Hospital. Thirty (37%) of these cases were males averaging 53.3 years of age. The 52 females averaged 55.9 years and the ages of all ranged from 20 to 72. The authors compare these figures with those in other reports published in the literature.

Fifty-four patients (66%) gave a history of symptoms referable to the biliary tract prior to the present attack, and only 6 definitely denied such symptoms. Many gave a history of gall bladder disease extending over a great many years.

The interval between the onset of the present attack of pain and its termination by operation or antecedent demise averaged 12 days for the men and 3½ days for the women. At this hospital, it was the policy to operate on acute cases only if it was deemed necessary because of a progressive lesion, and to wait for subsidence of the acute symptoms whenever feasible.

Abdominal pain in this series originated (1) in the right upper quadrant, (2) in the epigastrium, or (3)

as generalized abdominal pain. Fifty per cent of the patients reported radiation usually to the back, right shoulder or across the abdomen. Abdominal distention was not often noted but marked tenderness localized to the right upper quadrant was usually present. Nine patients reported a history of chills and fever with the present attack, and nausea vomiting or both were present in most cases. Only 10 specifically denied either of these symptoms. No consistent change in bowel habits was noted. Jaundice appeared in only 10 per cent of the patients during the present attack and only 1 per cent had a history of previous jaundice.

An enlarged mass in the upper right quadrant was definitely palpable on admission in 38 cases (46.3%). There was definitely none palpable in 35. The preoperative temperature was usually a sustained elevation sometimes as high as 103 degrees and other times barely elevated. A moderate temperature averaging about 101 degrees was usual. Blood pressure readings on admission varied widely but averaged 134/79 for men and 144/80 for women.

The average white blood count on admission was 15,600 cells per cubic millimeter for men and 15,870 for women (8.3% and 80.9%, respectively, were neutrophils). A great many of the patients showed a fall in the white blood count prior to operation, the males averaging 14,000 with 80.9 per cent neutrophils and the females 13,950 with 76.3 per cent neutrophils a day or so preoperatively. Since these cases were progressive with probably accompanying lesions this did not indicate an improvement in the pathological process. The red cell counts were quite normal in most cases with the exception of some concentration due to dehydration.

Fasting blood sugar tests were made on 61 patients 13 of whom were known diabetics. Levels less than 100 mgm. per cent were obtained in 30 cases (39% of the nondiabetic group). Nineteen (31% of the nondiabetics) had levels between 100 and 150. The remaining 12 nondiabetics had levels above 150.4 over 150. The somewhat elevated blood sugar levels were attributed to concomitant coronary occlusion, intravenous glucose therapy shortly before the test, and unrecognized diabetes mellitus. The authors believe there was nothing to suggest any tendency to produce an elevated fasting blood sugar as is known to occur in acute coronary occlusion. Blood urea nitrogen determinations in 63 cases were within normal limits in most cases.

An attempt to correlate the severity of the disease with clinical and laboratory data was considered inadvisable so the records of 2 cases of perforated gall bladders were studied separately. These cases represented 2.5 per cent of the entire group. They were not necessarily all recent perforations, some being well encapsulated by adhesions of omentum, and only 3 were associated with widespread peritonitis. Rupture into the duodenum occurred in 1 case.

The ages of the 9 men patients averaged 61.8 years and those of the 12 women 57.1 years, and nearly all

of the patients had an antecedent gall bladder history. Only 3 denied any prior biliary dysfunction. The average duration of the recent acute attack was 11 days for the females and 8 days for the males. The acuteness of the average perforated case was noted and earlier interference practiced 8 cases being operated within 7 days of the acute onset and 5 within 3 days. One third of this group had a palpable mass in the gall bladder region on admission to the hospital.

The pain of onset was diversified and more wide spread and the right upper quadrant pain and tenderness were more severe and more often present than in the general group. Two-thirds of the patients had extreme tenderness, abdominal rigidity, nausea and vomiting. The remaining one third consisted of cases in which the perforation was long standing with localized chronic abscess formation. These had very little tenderness or rigidity.

In the perforated group the admission white count averaged 16,600 with 83 per cent neutrophils. Three cases had counts in excess of 26,000.

Surgery of the gall bladder was performed in 73 cases (86% of the entire series). The operation varied from simple incision and drainage to complete excision according to the seriousness of the case. In approximately one half of the operative cases cholecystectomy was done. In the perforated group only 3 had cholecystectomies while 14 were treated by simple incision and drainage.

Spinal anesthesia was used in 59 (81%) of the operations. Supplementary anesthesia of nitrous oxide oxygen, ether or pentothal was used in 7 cases. Nine were done under local and 5 under general anesthesia and 14 of the perforated group were done under spinal and 3 under local anesthesia.

Stones were found in 65 patients (70%). In 11 cases they could not be definitely ascertained. Six cases definitely had none. Two-thirds of the perforated group had stones and only 1 definitely did not. The examination was not complete in the remainder.

Of the entire group of 81 patients, 20 died during their hospital stay. This group averaged 60 years of age. Of the 73 operative patients 11 died post-operatively a mortality of 15.1 per cent. Twelve of these patients died as a direct result of biliary disease, and 4 of causes uninfluenced by and unrelated to biliary disease.

In spite of the lessened trauma attending gall bladder incisions the mortality for this procedure was more than twice as much as for excision. For the most part the patients were poorer risks. In the mortality group the average interval between the onset of the attack and its termination by operation or prior demise was 10.5 days. The white count averaged 16,300 with 81.8 per cent of neutrophils.

There were 13 diabetic patients in the series (15.9% of the total) which correlates with the idea that diabetics have twice the tendency to develop gall stones. The average age was 61.4 years and 5 of these patients were males. One half were operated

on within a week, and 9 had palpable gall bladders preoperatively. The average white count was 15,200 with 81 per cent of neutrophils. Three cases perforated an incidence of 23 per cent. All these facts show a similarity between diabetic and nondiabetic cases. Eleven diabetics (85%) were operated on and 20 had gall stones. Two cholecystostomies and 3 cholecystectomies were done under spinal anesthesia. Seven diabetics (54% of the diabetics) died these deaths made up 35% of the total mortality. All of these deaths were due directly or indirectly to biliary disease.

The presence of gall stones in cases of acute cholecystitis in a far greater incidence than chance alone suggests points to a common etiology or to the fact that stones may play some role in the acute process. Since most patients have been suffering more or less from chronic gall bladder disease before developing an acute and dangerous condition, it may be wise to consider the prophylactic approach to the problem, i.e. the desirability of removing the gall bladder in all symptomatic cases of chronic cholelithiasis as a curative for symptoms and a preventive of complications. Certainly every case of acute cholecystitis that is allowed to subside should be operated on after a reasonable interval to preclude future more serious attacks.

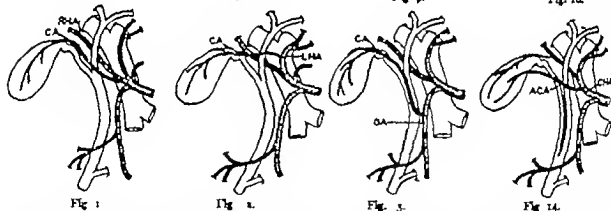
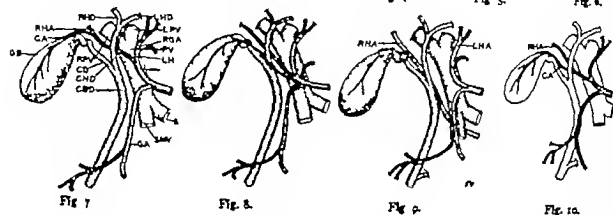
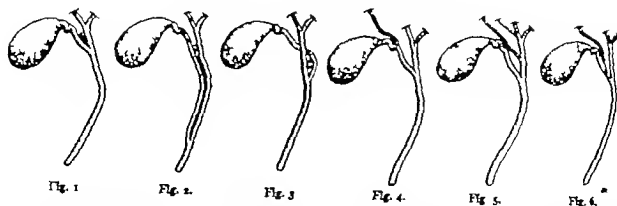
The authors believe that the severity of gall bladder disease depends directly upon the chronicity of a gall bladder condition. The diminished vascularity with increasing age and the fibrosis accompanying attacks may favor widespread venous damage with sudden vascular occlusion.

It is recognized that it is not possible to correlate the severity of the signs and symptoms with the degree of disease present in any given patient.

Although there is a marked tendency for diabetics to form stones, there is no unusual tendency for the diseased gall bladders in these cases to progress to suppurative or gangrene. The exceptionally higher mortality in these cases suggests that tissue destruction in the gall bladder is tolerated as poorly as elsewhere. Diabetic patients should not only be considered poorer risks for surgery in advanced gall bladder disease, but probably deserve more prophylactic surgery. ROBERT R. BRADLOW, M.D.

Oster, G. F., and Dow, R. S.: Variations and Anomalies of the Biliary Duct System and Its Associated Blood Supply. *Rec'd J. S. S. G.*, 1945, 53: 316.

Dissection was carried out on 30 cadavers to show variations in the extrahepatic biliary duct system and cystic artery. The cystic and hepatic ducts may join at an acute angle (Fig. 1) or follow a long straight or spiral tortuous course (Figs. 2 and 3). Accessory hepatic ducts were found in 6 of the 30 cadavers. They may unite with the gall bladder with the cystic duct (Fig. 4) with the right hepatic duct (Fig. 5) with the common hepatic duct or come into the angle at the junction of the cystic and common hepatic ducts (Fig. 6). Frequent variations



Figs. 1 to 4. Variations in the extrahepatic biliary duct system and cystic artery. ACA, accessory cystic artery; CA, cystic artery; CBD, common bile duct; CD, cystic duct; CHD, common hepatic duct; GA, gastroduodenal artery; OB, gall bladder; HA, hepatic artery; LHA, left

hepatic artery; LHD, left hepatic duct; LPV, left branch of portal vein; PV, portal vein; RGA, right gastric artery; RHA, right hepatic artery; RHD, right hepatic duct; RRV, right branch of portal vein; SAV, superior mesenteric vein; SV, splenic vein.

occur in the common hepatic, and right and left hepatic arteries.

The cystic artery a very important neurosurgically showed a good deal of variation. It may be normal i.e. arise from the right hepatic to the right of the common hepatic duct (Fig. 7) but may originate behind (Fig. 10) or to the left of the duct. It may come from the left hepatic artery (Fig. 12) or from the gastroduodenal artery (Fig. 13). Accessory cystic arteries are rare. One was found arising from

the hepatic artery (Fig. 14) another from the left hepatic artery.

The amount of variability in the extrahepatic duct system and its associated blood supply makes it of the utmost importance that the surgeon secure satisfactory visualization of these structures at the time of surgery.

The 14 figures here included show the various findings of this study.

RICHARD J. BROOKETT, JR., M.D.

Van Gelderen, G. Transpapillary Duodenal Drainage of Hepatic Duct (Die transpapilläre duodenale Hepatikusdrainage) *Acta chir scand* 1944, 90: 27

Insertion of a T tube into the common duct is fraught with the danger of a secondary cicatricial stenosis the drainage leads to a considerable loss of fluids and ions and in addition, the absence of bile in the intestines interferes with the resorption of fats. Moreover the loss of undigested fats impairs the absorption of proteins and calcium. Finally a deficiency of the fat-soluble vitamins A, D and K may be the sequel of the external drainage of bile.

For all these reasons it has been suggested that external drainage of the common duct be replaced by choledochoduodenostomy. However such anastomosis facilitates the development of ascending cholangitis especially because the new stoma is deprived of a sphincter. Therefore this procedure should be employed only if the papilla cannot be stretched and if one suspects small stones in the hepatic duct.

A primary closure of the common duct is not advisable in the presence of acute cholangitis as a rule. The primary closure is certainly contraindicated if an induration of the head of the pancreas compresses the outlet of the common duct. In such instances an internal drainage of bile is desirable. A rubber drain buried in the common duct is not always expelled through the duodenum and may be responsible for a recurrent cholangitis or formation of stone.

To obviate these drawbacks, Voelcker introduced a drain through the common duct into the duodenum and exposed the tip through a transduodenal incision, the drain was pulled through the opening in the duodenum and carried to the outside through a Witzel's fistula. The drain could be removed within a few days without leakage of the bile or duodenal contents.

The author modified Voelcker's procedure in the following manner: bougies are introduced through a choledochotomy to dilate the papilla and a rubber drain is carried from the common duct into the duodenum through the papilla. An incision is made in the duodenal wall over the protruding tip of the drain and a lateral opening is made in the tubing to establish an internal duodenal bile drainage. The drain is pulled and carried through a Witzel's fistula. The incision in the common duct is closed with catgut and the gall bladder is removed. The drain is brought out through a stab wound in the abdominal wall and clamped with a hemostat. Approximately one week after the operation the drain can be removed. In this manner acute cholangitis is successfully combated without external bile drainage. The icterus does not disappear as promptly as after external drainage but, on the other hand, dehydration is avoided and the general condition of the patient improves rapidly.

Only the part of the drain directed from the lateral opening in the duodenal portion toward the liver

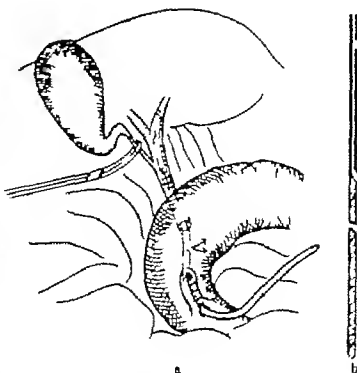


Fig. 1. a, Diagram of procedure. b Special drain about closed by interruption.

must be hollow while the remaining portion of the drain may be solid which avoids the necessity of a clamp.

The drain may be used not only in infected cases accompanied by high temperature but also in all cases in which a primary suture of the common duct does not appear dependable. The method is applicable also in patients with a chronic inflammatory induration of the head of the pancreas in whom it may replace a T tube or a permanent anastomosis. The author's drain may be employed also in reconstruction of the biliary ducts and after choledochoduodenostomy.

JOSEPH K. KARAT, M.D.

Peterson, L. W. and Cole, W. H.: Chronic Sclerosis of the Common Bile Duct Causing Complete Stenosis of the Common Bile Duct. *Arch Surg.* 1945 51: 25

Peterson and Cole wish to call attention particularly to the type of chronic pancreatitis associated with diffuse atrophy and fibrosis throughout the entire gland. Such a process may produce surprisingly little physiological or mechanical disturbance. However jaundice may develop and become permanent because of the severity of the sclerosing process involving the common duct.

While this condition is not common, the seriousness of destruction of the terminal end of the common duct by the progressive pancreatitis is sufficiently well appreciated that every effort should be made to treat acute pancreatitis early and eliminate it if possible. The etiological factor in the production of the usual type of acute edematous pancreatitis appears to be strongly related to cholelithiasis. The

fact that in some cases the pancreatitis subsides after cholecystectomy is suggestive proof of this relationship but it is by no means conclusive, since not infrequently cholecystectomy fails to stop the pancreatitis. Occasionally it develops after cholecystectomy.

Localized pancreatitis in the head of the pancreas, simulating carcinoma, is rather commonly observed by surgeons. The process which frequently produces complete obstruction of the common duct, usually subsides so completely within a few weeks or months that all symptoms disappear. The surgeon too often attributes the entire success of relief of obstruction to the short-circuiting operation, i.e., cholecystenterostomy.

Complete permanent obstruction of the common duct due to chronic pancreatitis is a difficult lesion to treat, but presents much less difficulty than obstruction due to complete absence or destruction of the common duct, because the remnant of the common duct simplifies the operative procedures. When the obstruction is due to localized pancreatitis involving only the head of the pancreas the prognosis for spontaneous complete recovery appears to be much better than when a generalized chronic sclerosing pancreatitis is producing a complete obstruction of more than transient type. Therefore, the customary operation of cholecystenterostomy for local pancreatitis in the head of the pancreas appears to be a logical procedure, particularly since the anastomosis will frequently remain open for only a few months at the end of which time the pancreatitis usually subsides completely with relief of the obstruction. The operation of cholecystenterostomy has one serious disadvantage namely the resulting development of cholecystitis and hepatitis which has been shown experimentally by Waggenster and others.

It is extremely difficult to differentiate chronic pancreatitis localized to the head of the pancreas and producing temporary complete obstruction of the common bile duct from carcinoma of the head of the pancreas without a deep biopsy from the lesion. In the even more rare type of diffuse chronic sclerosing type of pancreatitis operative therapy must be directed at establishing a permanent nonstenosing communication between the suprapancreatic portion of the common bile duct and the intestinal tract. In addition, the regurgitation of food and intestinal secretions must be prevented as much as possible.

Of the several operative procedures that have been described, each has some individual merit. The procedure of choice would be an anastomosis of the proximal stump of the common duct to the duodenum or an anastomosis of the proximal end of the common bile duct to the blind end of a single arm of jejunum utilizing the Roux principle. Into this blind loop of jejunum, through which food does not ordinarily pass, valves, as previously described, are placed to help prevent regurgitation of food. A side-to-side anastomosis has the added advantage of

allowing function of the terminal duct to be resumed if the pancreatic lesion should clear sufficiently to allow relief of the obstruction. If the terminal end of the duct is hopelessly destroyed, the duct may be mobilized and either a transplantation into the duodenum or an anastomosis performed. If the latter procedure is used, a vitallium tube may or may not be used, according to the size of the common duct.

BENJAMIN GOLDMAN, M.D.

Manninger S. R. and Dorody H. K.: Islet Cell Tumors of the Pancreas. *Surgery* 94:1, 18, 171.

The relationship of islet-cell tumors of the pancreas to hypoglycemia is now well recognized and there have been an increasing number of such cases reported in the literature of the last decade. Is Whipple's recent review on 149 cases of islet-cell tumor showing hypoglycemia there were 106 which were considered benign, 28 questionably malignant, and 15 definitely malignant with metastases to the liver.

The tumors may be single but two or more have been found in approximately 10 per cent of the reported cases. They are usually in the body and tail of the pancreas but may be in the head of the gland. They are dark red or purplish in color and are larger than the surrounding tissues. Their size varies, but it averages between 1 and 3 cm. in diameter. The benign tumors are encapsulated. They may show signs of degeneration, but in some cases they are definitely calcified. Microscopic sections of the cells are typical of islet cells.

The symptoms of islet-cell tumors may be hunger, faintness, perspiration, and vertigo or in addition, there may be signs related to the nervous system. Wilder has classified the nervous symptoms into three groups: (1) disturbances of the sympathetic nervous system with diarrhoea, nausea, pallor and sweating; (2) disturbances of the central nervous system such as convulsions with tonic and clonic contractions of the extremities and (3) psychic disturbances with anorexia, manic-depressive mental confusion and coma.

These attacks occur most frequently during periods of fasting or overfatigue at which times the blood-sugar levels are lowest. There is frequently a rapid response to the ingestion of glucose either by mouth or parenterally. Whipple has presented a triad for differentiation of islet-cell tumors: (1) attacks of insulin shock coming on during fasting or overfatigue; (2) blood-sugar findings of 50 mgm. per cent or less; and (3) prompt relief from the ingestion of glucose. When this triad is present the possibility of islet-cell tumor due to oversupply of insulin must be seriously considered. The differential diagnosis of hypoglycemia is a difficult diagnostic problem. The influence of other glands such as the thyroid, pituitary, adrenals and liver on the carbohydrate metabolism must be considered.

Surgery is indicated in the severely ill patients who have not responded adequately to palliative measures. The transverse or inverted-T incision is par-

ticularly suited to the operation on the pancreas. The gland may be approached through the gastrohepatic or gastrocolic omentum. If most of the greater curvature of the stomach is freed and reflected upward practically the entire anterior surface of the pancreas can be visualized. Islet tumors may be quite obvious or not visible at all. Removal of the obvious adenoma usually is followed by complete relief of the symptoms. However these masses may be multiple and additional tumors should be removed when present. When no tumor can be found the procedure is open to debate. The surgeon may postpone further surgery until the tumor is sufficiently developed to permit its location and removal, or an adequate portion of the pancreas may be resected with the idea of reducing the secretion of insulin, which treatment is similar to that of hyperthyroidism. This is done with the hope that the removed segment of gland may bear the offending tumor.

SAMUEL J. FOOTE, JR., M.D.

Cole, W. H. and Reynolds, J. T.: Resection of the Duodenum and Head of the Pancreas for Primary Carcinoma of the Head of the Pancreas and Ampulla of Vater. *Surgery* 1945 18 133.

After describing the various operations for primary carcinoma of the head of the pancreas reported in the literature by Whipple (1941), Hunt (1941), Orr (1942), Brunschwig (1943), and Child (1944), the authors submit their procedure which they now have done on 5 patients.

A long midline or modified transverse incision is made in the upper abdomen in order to determine whether or not the tumor can be dissected free from the superior mesenteric and portal veins. The common duct is next divided as far distally as possible. The gastroduodenal and inferior pancreaticoduodenal arteries are then ligated. The pylorus and distal duodenum at the ligament of Treitz are then divided. Then a long loop of jejunum is brought up for an end-to-side gastrojejunostomy. Into this long loop of jejunum the common duct is transplanted as much distance as possible being left between the site of transplantation and the gastrojejunostomy in order to minimize contamination or exposure to the food stream. The cut end of the pancreas was not transplanted into the intestine in this series of patients because to date very little ill effect has been

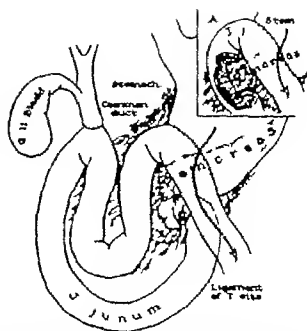


Fig. 1. Technique of the one stage resection of duodenum and head of the pancreas adopted after trial with several different types. Note that the common duct is transplanted proximal to the gastrojejunostomy so that the food stream will not pass over it but will pass downward (assisted by gravity) instead of upward and over the transplanted duct as in some operations recommended.

Insert shows an alternate procedure of transplanting the cut end of the pancreas into the jejunum. The proximal loop of jejunum is left long to make room for transplantation of the common duct and if desired, also the stump of the pancreas; however it need not be so long if transplantation of the stump of the pancreas into the jejunum is not done or contemplated.

observed by the various authors reporting on this subject following complete closure of the pancreatic stump.

It is advisable to insert a drain down to the stump of the pancreas because a pancreatic fistula develops so commonly in spite of efforts to ligate the pancreatic duct and close the stump of the pancreas with nonabsorbable sutures.

One of the first 5 patients operated upon died but as yet insufficient time has elapsed since surgery to determine the prospects of cure.

SAMUEL J. FOOTE, JR., M.D.

Danforth W. G. Vaginal Hysterectomy in the Management of Descensus Uteri. *Am J Obst* 1945 50 376

In 160 of a little more than 600 vaginal hysterectomies, the operation was done for descensus of greater or less degree.

In 1 case death occurred. The patient was a woman in whom the protrusion was about 5 or 6 cm. She came through the operation well but got out of bed the first night and was controlled with some difficulty. She developed pelvic inflammation and shortly thereafter pneumonia. The latter was the determining cause of death.

Vaginal surgery requires a definite knowledge of the anatomy of the region in which the procedure is carried out. It also demands a familiarity with the technique of the operations which are done in this field. The specialist in pelvic surgery should be familiar with both the anatomy and technique for the results of operations for descensus done from below are so much better than those following abdominal procedures that the latter should give way entirely. The safety of the operation done from below is greater and this fact should weigh heavily in the choice of procedure. It is the author's opinion that vaginal hysterectomy rather than the procedures of the Manchester type particularly in cases of extreme descensus, is the operation of choice. In cases in which the descensus is of moderate degree either will serve. As in many patients the uterus has passed its usefulness and especially inasmuch as the cervix is often unhealthy removal of the uterus has a much larger field of usefulness than the alternate procedure.

EDWARD L. CORNELL, M.D.

MISCELLANEOUS

Abartanek, A. R., and Leatham, J. H.: Studies in Amenorrhoea, Oligomenorrhoea and Anovulomenorrhoea. The Effect of Equine Gonadotropin upon the Establishment of Cyclic Menstruation and Ovulation. *Am J Obst* 1945 50 562.

Twenty two patients with clinically hypofunctional ovarian activity were studied. These included 3 with primary amenorrhoea 11 with secondary

amenorrhoea 8 with oligomenorrhoea and 1 with cyclic anovulomenorrhoea. Adjuvant therapy with equine gonadotropin was instituted in these cases the amounts varying from 400 to 4,000 units.

This hormone failed to establish menstruation in 3 cases of primary amenorrhoea.

Of the 11 cases of secondary amenorrhoea ovulation was apparently stimulated in 2 although the result in 1 was open to serious question. Only 1 patient continued to have regular menses.

In the 7 cases of oligomenorrhoea the equine gonadotropin apparently restored cyclic menses in 1 case but failed to stimulate an ovulatory response in any.

In the 1 case of regular anovulomenorrhoea equine gonadotropin was ineffectual.

Nine of these 22 patients were later salvaged with an adequate diet and usually thyroid extract.

Clinically equine gonadotropin proved to be a rather ineffectual stimulant to the abnormally functioning or hypofunctioning human ovary as far as the restoration of normal cyclic metabolism and the reappearance of regular menstrual rhythm was concerned.

Equine gonadotropin produced similarly poor results in stimulating an ovulatory response in patients with clinically hypofunctioning or abnormally functioning ovaries.

The principle of heterogeneous substitutive therapy with equine gonadotropin may yield far greater harm than any temporary good. The possible harmful results of therapy with equine gonadotropin are (a) a gonadotoxic effect on the ovary as evidenced by abnormal stimulation or marked delay in the appearance of the next menses (b) the development of antagonistic (antigonadotropic?) substances with neutralization of subsequent injections of equine gonadotropin, (c) the development of allergic manifestations which may be severe in spite of negative skin tests and (d) the sensitization of the patient to other as yet unknown components of horse serum.

The principle of physiological stimulative therapy by means of a nutritionally balanced diet and desiccated thyroid extract is far more rational and far more efficacious both on theoretical considerations and with regard to the clinical results obtained.

EDWARD L. CORNELL, M.D.

PREGNANCY AND ITS COMPLICATIONS

Berman W.: Congenital Absence of the Sacrum and Coccyx Complicating Pregnancy. *Am J Obst* 1945 5 447

Röntgenograms of the pelvis of a 20 year old primipara at term showed a single fetus with its back to the left and the small parts to the right. The head was above the pelvic inlet and ballotable on palpation above the brim of the pelvis. The head appeared to be full term in size. The pelvic inlet was asymmetrical. The vertebral column was straight and terminated at the junction of the last lumbar vertebra and the pelvic girdle. There were two marked depressions at the site of the posterior superior spines of the ilium. There was almost a complete absence of the interpleural fold, and the subcutaneous tissue and muscle formed a partially loose apron over what would normally be the sacrum.

The uterus responded to labor like any other normal uterus. Contractions were regular and of sufficient strength to require the use of some analgesia. The cervix dilated but there was no descent of the head.

After 24 hours of active labor without progress, a low classic cesarean section was done. The infant died shortly after delivery. Autopsy revealed that it had a congenital heart lesion and complete atelectasis of all lobes of the lungs. A roentgenogram failed to reveal any abnormality of the bony structure of the infant's pelvis.

Edw and L. Coakley, M D

Chealey L. C., and Williams, L. O.: Renal Glomerular and Tubular Function in Relation to the Hyperuricemia of Pre-Eclampsia and Eclampsia. *Am J Obst* 1945 59 367

Simultaneous measurements were made antepartum of the serum clearances of insulin, urea, and uric acid in 10 normally pregnant women near term, and in 10 women with pre-eclampsia and eclampsia. In all but 3 of the normal women, the tests were repeated postpartum.

In pre-eclampsia and eclampsia the uric acid clearance is reduced. In this series, the diminution averaged 50 per cent. On the average, the reduction in uric acid clearance depends equally upon 2 factors, viz., (1) a decrease in the rate of glomerular filtration, and (2) an increase in the tubular reabsorption of uric acid from the glomerular filtrate. The increased tubular reabsorption of uric acid is the more general of the 2 factors.

Published data of other workers have been interpreted to support these conclusions. The diminution in uric acid clearance appears adequate to explain the hyperuricemia of pre-eclampsia and eclampsia.

Edward L. Coakley, M D

Leonard, M. F.: Hemolytic Disease of the Newborn (Erythroblastosis Fetalis). *J Pediatr* S. Lusk, 1945 7 249.

Fifty five cases of hemolytic disease of the newborn treated at the New York Hospital, New York, in the 6 years from 1938 to 1944, are summarized. The clinical picture was extremely varied, jaundice, anemia, the degree of erythroblastosis, and hemorrhagic manifestations varied independently. A high incidence (44 per cent) of bonepneumonia was noted. The effects of transfusion with Rh-positive Rh-negative blood and bank blood were typed for the Rh factor were compared. The immediate results following the transfusions in raising the hemoglobin and improving the clinical condition were equally good but Rh-negative blood transfusions resulted in a better sustained rise in hemoglobin, fewer reactions and lower mortality. Nine infants died, a mortality of 34 per cent. One of the chief causes of death was hemorrhage.

Jaundice out of proportion to or in the absence of anemia was attributed to impaired liver function. This theory was supported by the fact that low prothrombin levels responded poorly to vitamin K administration, by the pathological findings of fatty degeneration and necrosis of the liver and the evidence obtained from the literature.

The necessity for immediate transfusion in the presence of normal blood levels was questioned, and reasons were given for delaying transfusion until anemia impends. Plasma infusions were preferred in this type of patient.

The prominence of hemorrhagic tendencies in patients with hemolytic disease of the newborn was emphasized and its relation to low prothrombin levels demonstrated.

Administration of vitamin K to donors of Rh-negative blood was suggested as a means of raising the prothrombin levels of affected infants.

CHARLES B. ROSS, M D

Miller H. C.: The Effect of the Fetal and the Birth Weight of the Newborn Infant. *England J Med* 1945 33 376.

One of the outstanding characteristics of pregnancies in diabetic mothers is the high fetal and neonatal mortality rate. In addition, in some infants born to diabetic mothers there are striking somatic and visceral changes, including an increase in birth weight, cardiomegaly, hyperplasia of the islets of Langerhans, excessive extramedullary erythropoiesis, hyperplasia of the adrenal gland, and an increase in the eosinophil elements of the anterior pituitary body. Similar observations have been made on infants born to mothers who were

diabetic at the time of delivery but in later months or years developed signs and symptoms of diabetes. Since all the mothers who have been studied thus far became diabetic during the childbearing period, that is, under 40 years of age, it was considered desirable to extend the observations to infants born to mothers whose diabetes appeared after they had passed the fourth decade.

The fetal and neonatal mortality rates and the average birth weight are increased among infants born to mothers who subsequently manifest diabetes mellitus, even though the latter do not develop the disease until after forty years of age. The fetal and neonatal mortality rates increase as the onset of maternal diabetes is approached. Maternal obesity is not a factor in the increased average birth weight of infants born to prediabetic mothers who become diabetic after the age of 40. CHARLES BARON M.D.

Comfort, A.: Congenital Syphilis in an Infant Treated with Penicillin. *Lancet* Lond. 1945 249 431

A syphilitic mother was given 8 injections each of napharside 0.04 gm. and bismuth 0.2 gm. and a month later gave birth to a child weighing 6 lb. 3 oz. at birth. At one month of age the female infant was found to have strongly positive Wassermann and Kahn reactions, and two weeks later developed a rash, nasal discharge and dyspnea. Her weight at this time was 7 lb. 14 oz. Her frontal bosses were prominent, her scalp was covered with thick black hair and the upper ends of the tibiae were tender and enlarged. The body was covered with a scaly polymorphic maculopapular rash and there was a copious mucopurulent bloodstained nasal discharge. The respiratory rate was 36 and moist sounds were heard in all areas of the chest. The temperature now rose to 106.5°F. and the respiratory rate to 70, an area of impaired resonance with tubular breathing developed on the right side and extended up the spine.

The child was started on sulfapyridine (1.75 gm.) in 4 hour doses, but on the second day intramuscular injections of 38,000 units of penicillin were started and stopped after 412,000 units had been given. Thereupon the temperature rose to 108°F. but it fell soon afterward to 102°F. The general condition of the patient remained about the same, the pertinent blood findings at this time being polymorphs 30 per cent and lymphocytes 50.5 per cent. Four hour injections of penicillin 9,500 units were started again and in 24 hours the temperature had fallen to normal, the nasal discharge had ceased and the pulmonary signs had begun to clear. However, an additional 95,000 units were given before the drug was stopped. Immediately the temperature rose again and there was a slight return of the nasal discharge. The epiphyses were larger and very tender. Injections of ung. hydrarg. nit. fort. to the abdominal wall was begun and 4 injections of 0.5 ccm. of acetylarsan were given every third day. After this the respiratory rate was still high but

pulmonary signs were almost absent. The temperature range was lower from 100 to 102°F.

Immediately the 4 hour injections of penicillin in 9,500 units were resumed. Once more the fall in temperature to normal was immediate and after a further 95,000 units were given it remained down.

Finally 4 days later 100,000 units of penicillin were given over a period of 3 days whereafter all medication was stopped and a week later the Wassermann and Kahn reactions were negative and the epiphysitis had subsided. Thus before the reversal of the Wassermann reaction there were administered 702,000 units of penicillin, and 3 c.c. of acetylarsan, also some mercury and potassium iodide. Since then the child has remained practically well and the Wassermann reaction has remained negative. A convergent squint persists but vision appears to be present and there is no choroiditis.

From this experience the author concludes that in these acute cases of congenital syphilis the combined therapy as given in detail should remain the method of choice. JOHN W. BRENNAN M.D.

MISCELLANEOUS

Miller V. F.: Tubal Patency Tests. *J. Am. M. Ass.* 1945 130 243

Uterotubal insufflation and uteroosalpingography are widely accepted and well established procedures for the determination of tubal patency or its absence, and the latter is discussed with regard to sterility in the female. This survey of hundreds of tubal insufflations and 400 cases of uteroosalpingography over a 24 year period shows the value of these procedures and has led to significant conclusions.

Genital infection, either salpingitis or cervicitis is the chief contraindication to the performance of either of the mentioned tubal patency tests like was pregnancy constitutional disease and pelvic neoplasms also contraindicate these tests. Thorough knowledge of the menstrual history and a pelvic examination immediately prior to the test are essential. The week following menstruation is the most satisfactory time for the performance of either test.

The use of gas insufflation and the intrauterine introduction of radiopaque substances are supplementary tests both necessary for a complete evaluation of tubal patency. The former procedure is used initially and the latter is generally reserved for those cases in which patency is not found following insufflation. In the simple procedure of introducing air or carbon dioxide (preferred) into the uterine cavity pressure observations are essential. A rise in pressure (under a constant slow flow of no more than 300 c.c.) to 120 mm. and a falling off to from 30 to 60 mm. is encountered with normally patent tubes. A progressive and persistent rise in pressure is reasonable evidence of nonpatency. Hystographic recordings of manometric data are important. In substantiating patency in both tubes or localizing it

In one the symptoms, first of lower quadrant pain and then of shoulder pain should be correlated with manometric readings and with auscultation over the right and left lower quadrants to ascertain if air is escaping from the tubes. The importance of repeated testing on successive occasions is stressed.

Röntgen visualization of the tubes is essential when atresia or complete tubal closure is revealed by insufflation, and permits more accurate localization of the obstruction, particularly when salpingostomy is contemplated. From 6 to 10 c.c. of a warm opaque medium such as lipiodol are used, and observations are made under fluoroscopy of the escape of the oil from the ostia or its retention in the tubes. Immediate 24 hour, and 48 hour roentgenograms are essential in each instance as a permanent record and often disclose the late escape of oil or the presence of oil in the peritoneal cavity to refute an earlier impression of non-patency. The therapeutic effect of oil in opening closed tubes has been observed, especially when the procedure is repeated. Although an ideal oil, which is nonirritating and affords a good visual contrast on the x ray plate at the same time has not been found the incidence of morbidity attendant on this procedure appears to be slight. On the basis of available data insufflation results in morbidity in less than 1 per 1000 cases; gas embolism is the chief pathological cause in the rare case. The percentage of morbidity following the use of oil is slightly higher, oil embolism having been reported in some cases during the earlier years of the development of the tests.

Both tests when used in conjunction with one another and when properly performed are safe and highly informative for the diagnosis of tubal patency.

PATRICIA B. CRANE, M.D.

Rinehart, R. E.: Serum Protein in Normal and Toxemic Pregnancy. *Am. J. Obst.*, 1945, 50: 41.

Two hundred and fifty-one determinations of the serum proteins of 79 normal pregnant women and 50 on 5 pre-eclamptic women were made.

The average value for serum globulin remains almost constant throughout normal and toxemic pregnancies. During the normal pregnancy the average value for the total protein tends to fall from the nonpregnant level to a minimum during the eighth and ninth month and to rise rapidly to normal after delivery. At its lowest point this represents a decrease of 7.1 per cent from the nonpregnant average. This decrease in the concentration of total protein is confined primarily to the albumin fraction. The albumin decreased from a nonpregnant average value of 4.0 to 3.0 gm. per 100 c.c., a fall of 4 per cent. The average value for total protein as pre-eclampsia was 14 per cent below that of normal women in the same stage of pregnancy. This decrease in total protein is confined to the albumin fraction. It was 13 per cent lower than the lowest average value obtained at any time during normal pregnancy and 33 per cent lower than the average for normal nonpregnant women.

The probable dependency of these changes on known alterations of the function of the liver during pregnancy has been considered. A total of 15 determinations of the serum protein in simultaneous drawn maternal blood and blood of the cord was made. The albumin content of maternal serum and serum of the cord is nearly identical; a slight difference is noted in the globulin fraction.

Vaux, N. W., and Rakoff, A. E.: Estrogen-Progestins; A New Approach in the Treatment of Habitual Abortion. *Am. J. Obst.* 1945, 50: 33.

A study was made of a group of 24 patients with habitual abortion who were treated with estrogen and progesterone. These patients had gone through a total of 80 previous pregnancies from which there had resulted only 7 living babies (9%). There had been 53 abortions, 13 miscarriages, 2 stillbirths, and 1 premature live birth in which the infant did not survive. Fifty-four per cent of the patients had no difficulty in becoming pregnant, 8 per cent were of diminished fertility and 38 per cent were of poor fertility. In none of these patients were there any pelvic abnormalities or systemic diseases which would influence abortion. In only 1 patient was the basal metabolic rate diminished. Two patients had Rh incompatibilities (Rh-negative wife and Rh-positive husband). One of these delivered a normal living baby and the others aborted in neither case did Rh antibodies develop.

Information about the endometrium obtained by biopsy or curettage was available in 11 cases before the present pregnancy. Good secretory function was noted in 7 cases; impaired secretory function in 2, and an interval endometrium in 2.

Urine hormone assays were made in 15 cases prior to the onset of pregnancy. Urine gonadotrophic assays made at the midcycle were normal in 37 per cent. Urine estrogen assays made at the midcycle and during the third week of the cycle were diminished in 67 per cent, while low or absent pregnandiol values were obtained in 53 per cent. Since these studies were made in only one cycle, their significance is limited.

Hormone assays consisting of determinations of the urine pregnandiol, serum estrogens, and serum gonadotropins were made early in pregnancy in 19 cases. In almost all of the cases one or more additional assays were made and in 3 cases monthly assays were done.

On the initial assay 95 per cent of the cases showed normal serum gonadotropins. Seventy-nine per cent had diminished serum estrogens and 83 per cent had diminished pregnandiol titers. In 13 of the 19 cases studied, both the estrogens and pregnandiol were diminished. These findings indicate a deficiency of the corpus luteum during the early weeks of gestation and an inadequacy of the placenta to take over its functions.

Many of the patients had been unsuccessfully treated in previous pregnancies with progesterone, thyroid, and vitamin E.

During the present pregnancy all patients were treated by the injection of progesterone (10 mgm) and alpha-estradiol benzoate (10,000 rat units) given together two or three times weekly. This treatment was generally continued to the period of viability or later.

There was fetal salvage of 16 babies, or 67 per cent. There were 15 full term live births (with 1 neonatal death due to congenital abnormalities) 3 premature live infants (2 survived) 2 miscarriages and 4 abortions.

EDWARD L. CORNELL, M.D.

Nicodemus, R. E., Ritmiller, L. F., and Ladden, L. J.: Continuous Caudal Analgesia in Obstetrics on Trial. *Am J Obst* 1945 50 312

Of 500 deliveries with caudal analgesia 469 of the patients had complete relief of pain and 16 had partial relief. 15 patients were unrelieved. The authors state that caudal analgesia has given a higher percentage of complete relief to the mother than any other method or any combination of methods that they have employed. They believe that no other anesthetic is required and that it is not necessary to call an anesthetist to control the patient for the final delivery and repair.

In the authors' experience, the patients were nearly always ready to eat a little food and drink fluids immediately after delivery. In fact, many of them were able to do so during the course of their labor all of which aided greatly in the maintenance of normal blood chemistry and consequently fluid and nutritional balance.

The analysis shows that in patients in whom caudal analgesia was used the labors were longer and uterine contractions were of less intensity and the

expulsive force of the abdominal musculature was lost. Spontaneous rotation occurred less often in occipitoposterior positions and operative deliveries were increased. Breech deliveries were easier and safer. There was a lower incidence of stillbirths, a lower maternal morbidity, diminished blood loss with delivery, less permanent damage to the birth canal, and the patients were pleasant happy and co-operative.

EDWARD L. CORNELL, M.D.

Hanley B. J. and Malone G. M.: Caudal Analgesia in Obstetrics with Special Reference to Repeated Single Blocks. *Am J Obst* 1945 50 306

The authors present the results obtained in a series of 1,935 patients with caudal block. A technique for complete analgesia and delivery under repeated single caudal injections with $\frac{1}{4}$ per cent tetracaine is described.

Single caudal block technique has a definite place in the practice of obstetrics. Its use is varied. It can be used as a single block for delivery, or it can be repeated throughout labor for analgesia and delivery. The results with caudal anesthesia and obstetric surgery are very encouraging. Single caudal block, when administered by an experienced individual under proper conditions, can be as safe as other forms of analgesia or more so.

Caudal block administered correctly will give as good results as any other form of analgesia. The use of interrupted single caudal blocks for analgesia and delivery gives promise of effectiveness and safety for mother and child. Caudal anesthesia in obstetrics should be limited to well equipped institutions which have a full time resident or a teaching staff.

EDWARD L. CORNELL, M.D.

GENITOURINARY SURGERY

ADRENAL, KIDNEY AND URETER

Macgrath, B. G., Harvard, R. E., and Parsons, D. S.: Renal Syndrome of Wide Distribution Induced Possibly by Renal Anoxia. *Lancet*, Lond. 945 249-293

The authors discuss the nature and distribution of a type of renal failure seen in a great variety of acute illnesses. The syndrome is a condition of impaired renal function developing usually in an acute illness and often associated with a transient peripheral circulatory failure. The onset of oliguria or anuria is commonly the first sign. In patients who survive there is also a postanuric period of impaired renal function, with nitrogen retention and often a copious unconcentrated urine. The postanuric period may last for several weeks, but eventually there is complete and permanent recovery. The reversible nature of the renal failure is the chief feature that distinguishes this syndrome from the other forms of nephritis.

In patients who die the kidneys have a characteristic appearance postmortem. They are usually enlarged, with a swollen, pale cortex and often an engorged medulla. The epithelium of the convoluted tubules is degenerated, necrosed, or desquamated. The damage may be concentrated chiefly in the ascending loop of Henle and in the distal convoluted tubules. The lumina of the tubules are usually filled with debris and with desquamated cells either in tact or fragments. The debris is often stained deeply by the pigments which may be present in the urine at the time the lesions develop. It is a constant observation that the glomeruli and their capsules appear nearly if not quite, normal. The vessels of the medulla on the other hand, are usually engorged and often there are apparent hemorrhages into the lumina of the tubules.

The main features have been noted in widely differing conditions. In blackwater fever incompatible blood transfusion, and in icterus neonatorum there is extensive intravascular hemolysis but in recent years the syndrome has been frequently observed in crush syndrome, in which hemolysis is lacking. In the above mentioned conditions the syndrome is always associated with the presence of pigment in the urine, and it has been thought that the pigment, if not the immediate cause of the anuria is the cause of the damage to the renal tubules. However experiments designed to establish this have been inconclusive. The syndrome develops in many conditions in which abnormal pigment is absent from the urine. In the alkalosis of gastric tetany that may arise during the treatment of peptic ulcers similar nitrogen retention occurs accompanied by similar characteristic changes in the kidney. There are also many other conditions in which the features of this syndrome have been re-

ported. The anuria, the impairment of renal function, and the characteristic microscopic appearance of the kidney have been described in cases of septic abortion, cholera, yellow fever, Weil's disease, diabetes, hepatorenal syndrome, pernicious anemia, and carbon monoxide poisoning.

Three different causes have been suggested. (1) mechanical blockage (this does not account for the many similar cases of anuria in which pigment is absent, and it has now been generally abandoned) (2) a "nephrotoxic" effect of some injurious substance carried to the kidney by the blood-stream. (3) renal anoxia, the main cause of renal damage being the temporary deprivation of oxygen.

The nephrotoxic theory demands that a wide variety of toxins many of them hypothetical or at least unidentified, shall all produce syndromes which are very similar in their clinical and pathological appearances. The situation is not unlike that existing in the study of rickets before the discovery of vitamins.

The authors express the opinion that the evidence at present available favors the hypothesis that renal anoxia plays a large part in producing this syndrome, in that it results in damage to the renal epithelium, and consequent impairment of renal concentrating power. The oliguria and anuria that occur in many instances are probably the direct result of the disturbances of renal blood-flow that follow peripheral circulatory failure. If this is correct, it has an important practical application, for the prevention of anuria in these conditions will then depend more upon the support given to the circulation than upon efforts to keep the urine alkaline. Blood transfusion is the most effective means of providing the depleted blood stream with fresh oxygen-carrying power in conditions in which "shock" is accompanied by anemias, as in traumatic hemorrhage and in blackwater fever. To be effective however it must be given early.

The authors suggest that 'renal anoxia' is a suitable name for the syndrome.

JOSEPH K. NARAI, M.D.

Goyanna, R., and Greene, L. F.: Pathological and Anomalous Conditions Associated with Duplication of the Renal Pelvis and Ureter. *J. Urol. Med.*, 1953, 54: 1

Complete duplication of the renal pelvis associated with complete or incomplete duplication of the ureter is a common anomaly which in itself has no clinical significance. At the Mayo Clinic it was found 25 times in 2,000 consecutive autopsies, an incidence of 1.25 per cent. It is sometimes contended that duplication makes the upper part of the urinary tract more liable to pathological conditions. If such is the case, and in view of its relative frequency duplication may assume clinical importance.

If some associated pathological or anomalous condition is present one of the segments may be non-functioning and therefore roentgenographically invisible, which would create diagnostic difficulties. In a 10 year period 131 patients at the Mayo Clinic presented 154 pathological or anomalous conditions associated with complete duplication of the pelvis and complete or incomplete duplication of the ureters. The so-called bifid pelvis although theoretically a type of duplication was not included for its frequency is so great that it may be considered more as a normal variation than as a true anomaly.

The most common pathological condition found associated with duplication was hydronephrosis or hydroureter or both. This was twice as common on the right as on the left side and nearly twice as common in the lower as in the upper segment.

The fact that the incidence of pyelonephritis, pyonephrosis and atrophic pyelonephritis also is higher in the lower segment than in the upper one may be considered a consequence of the faulty drainage of the hydronephrosis. In all cases of ectopic ureter and in all cases of ureterocele associated with duplication, the ureter from the upper pelvis was the one affected.

The diagnosis of duplication is usually made with out difficulty by means of an excretory urogram. However if one of the segments is nonfunctioning the excretory urogram may appear normal. The following roentgenographic signs are suggestive of duplication (a) elongated renal shadow (b) the presence of a region of kidney with no means of drainage, or (c) the shape of the visualized pelvis.

Excretory urography alone cannot be depended upon to distinguish between complete and incomplete duplication of the ureters, unless the entrance of both ureters into the bladder is clearly seen. Cystoscopy and retrograde pyelography although helpful, may fail when the supernumerary orifice is hidden or when there is incomplete duplication.

A history of congenital incontinence associated with normal micturition is strongly suggestive of duplication with an ectopic ureter.

JOSEPH K. NARAT, M.D.

Shearer, T. P., Wiper, T. B. and Miller, J. M.: Renal Caruncles; a New Method of Treatment. *J. Urol. Balt.* 1945 54: 12.

The majority of renal caruncles reported in the literature have been treated by nephrectomy. In many instances, the lesion is of such size that considerable functioning renal tissue is sacrificed. However to date, mortality statistics favor the more drastic procedure of nephrectomy instead of incision and drainage alone or incision and drainage combined with nephrectomy at a later period. These mortality figures hold although nephrectomy is often extremely difficult even when a small inflammatory lesion is present. The perinephric tissues in these instances are frozen and the kidney is closely adherent to the surrounding structures, which makes its removal very difficult.

An almost universal observation is that the renal caruncle is preceded by a cutaneous infection such as a paronychia, boil, or a carbuncle. The time intervening between the cutaneous infection and the onset of symptoms due to renal disease varied from a few days to many months.

The symptoms are usually nonspecific in nature and do not point directly to the urinary tract as the seat of the difficulty. Malaise at times progressing to prostration chills, and fever is present. Urinary symptoms are lacking. It is not surprising therefore that the average length of time between the onset of illness and the institution of surgical treatment has been 66 days.

The authors have had occasion to treat an individual with a renal caruncle successfully by incision and drainage, combined with the administration of penicillin via the systemic and local routes. The patient was a 20-year-old white male whose presenting symptom for 2 months was pain of moderate severity in the left lower chest and upper abdomen. The pain was associated with temperature of a septic type which at times was as high as 103 degrees. Upon inquiry the patient stated that 4 days before the onset of pain he had had several boils on his face and 2 carbuncles in the right cervical region.

Laboratory examinations gave no information. The patient presented a few moderately enlarged lymph nodes in the inguinal regions and the intercostal spaces. Special studies of blood smears did not reveal evidence of a blood dyscrasia.

A review of the excretory urograms made before submission of the patient to treatment demonstrated the calyceal compression mentioned before. Retrograde pyelograms revealed that the middle and lower calyces of the left kidney were smaller than normal and were pushed medially. There was no alteration of the psoas muscle shadows in these roentgenograms.

The preoperative diagnosis was renal caruncle. As penicillin was available for postoperative therapy incision and drainage was deemed the procedure of choice.

The usual lumbar incision for exposure of the left kidney was employed. This incision was satisfactory but exposure was technically difficult because of the great number of adhesions which bound the kidney to the surrounding structures. Some increase in exposure was obtained by subperiosteal resection of a segment of the twelfth rib. The kidney was freed to the hilar structures anteriorly and posteriorly and carefully palpated. An aspirating needle was passed into several suggestive areas and purulent material was finally obtained from a site deep in the substance of the kidney at the junction of the upper two-thirds and the lower one-third. Subsequent needle punctures delineated the cavity which was entered with a ureteral scalpel. Ten cubic centimeters of thick purulent material were released and a No. 16 F. catheter was sutured into the cavity. Bacteriological examination of this material estab-

lished the presence of a hemolytic staphylococcus aureus in pure culture. One Penrose drain was placed at the upper pole of the kidney and a second one at the lower pole. The wound was closed in layers.

Penicillin treatment was instituted and 200,000 units of the drug were administered intramuscularly every day. In addition the abscess cavity was lavaged twice daily with 5 c.c. of a solution of penicillin containing 550 units per cubic centimeter. The response to treatment was gratifying. A scanty serous discharge persisted for about 3 days. The operative wound healed nicely and the temperature gradually became normal. Improvement in the general condition was rapidly apparent. Retrograde pyelography 25 days after operation revealed complete restoration of the calyceal structures to normal.

JOHN A. LOFF, M.D.

Tahara, C., and Hara, E.: Massive Renal Fibro-lipoma. *J. Urol. Balt.*, 94:5 54, 57.

Two enormous fatty tumors of the kidney are herewith reported. It is interesting to note that these tumors had existed for a considerable period of time, that they caused, apparently, hypertension and loss of weight and that they were both associated with a unilateral chronic pyelonephritis. In both of these cases, nephrectomy has reduced the blood pressure to somewhere within normal limits. Both patients were markedly improved by the surgery and both cases must be considered as benign from the pathological reports, but with definite malignant characteristics.

JOHN A. LOFF, M.D.

Goldstein, A. E., and Klotz, H.: Ligation of a Supernumerary Ureter. A Clinical and Experimental Study. *Am. J. Surg.* 1943 70, 13.

Intentional ligation of a ureter without performing a nephrectomy is rarely ever done except in experimental work. Intentional ligation of a supernumerary ureter without performing a heminephrectomy is the subject of discussion in this article.

The clinical application of ligation of a supernumerary ureter was used by the authors in 4 instances on 3 private patients, 1 patient having the operation performed bilaterally because of pain in bilateral supernumerary fused kidneys. The operation in all of the cases was performed because of pain either in the lumbar or abdominal region. In 3 cases the discomfort or pain was on the left side, whereas in 1 case it was bilateral. The pain had been present between 6 months and 7 years. It was intermittent at first but later became constant in all of the cases, and, although not sharp, was very acute in 2 cases, simulating either a kidney colic or Dietl's crisis. Activity seemed to increase the pain. None of the patients showed any evidence of infection either by the presence of pus or organisms. All were females under 40 years of age, 1 having borne children, whereas 2 had not. Two of the 3 were married.

Functional studies revealed a good output in the opposite kidney as well as a good excretion in the

lower normal segment. The function of the supernumerary or upper segment was found to be fair. The capacities of the pelvis of the upper segment were less than those of the lower ones, ranging between 3 and 5 c.c.

The pyelographic studies were made both by the intravenous and the retrograde method, and it was observed in all of the cases that the pelvis and the calyces of the upper segments were smaller than the pelvis and calyces of the lower ones. A reproduction of the pain was obtained in all the cases by inserting the supernumerary segment with water.

Numerous dilations, first of the supernumerary ureter and then of the other ureter on the same side, were performed in all of the cases. The number of dilations of the supernumerary ureter varied from 3 to 12. In 1 case the supernumerary ureter presented a real stricture at the orifice. In the other cases a No. 6 catheter met a slight obstruction which was easily overcome. None of the cases showed a dilatation of the supernumerary ureter.

The emptying time seemed to be normal, from 1 to 8 minutes, in all of the supernumerary segments.

Previous to the operation a catheter was placed in the supernumerary ureter. The ureter was exposed extraperitoneally through a Gibson incision. The midthird of the ureter was selected for the ligation. After the ureter had been freed for a short distance, 3 chromic catgut ties were placed around it, about 1/4 cm. apart. The ureter was cut so that 1 of the ties were left on the lower portion and 2 were left on the upper portion. A small portion was removed for examination. The upper portion of the ureter was observed for a few moments but no great perceptible dilatation occurred. No leakage of urine resulted from the operation so that the wound was closed without drainage.

All of the wounds closed by first intention. Particularly enough, while the patients had some pain after operation, which was the result of the operation, they all claimed it was of a different type. In all, the original type and location of pain seemed to have disappeared immediately after the operation.

Pyelograms of the remaining kidneys were made by the intravenous route. When the pyelograms were made it was observed in all cases that the dye did not come through the supernumerary segment but through the other 2 kidneys. In normal time, and that the appearance of the remaining pelvis was the same as in the original retrograde pyelograms.

The patients were discharged in from 12 to 22 days.

In this study it was observed that after a ureter is ligated and cut a hydronephrosis immediately starts. Although this never assumes a very large size, it is present. From a functional standpoint, the ureter ceases to secrete very shortly after ligation, which fact was also borne out by the experimental work, so that when an intravenous pyelogram was made, no dye was found in the kidney pelvis or calyces.

The pain appeared to subside almost immediately after the ligation although there was some side

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the lumbar region for about 3 months in 2 of the cases which was described as a different type of pain. This was probably a postoperative ache that might be encountered following any operation. These cases have been followed from 6 to 7 years.

JOHN A. LOER, M.D.

BLADDER, URETHRA, AND PENIS

Jekely E. A. Bilharziasis of the Bladder (Vesical Schistosomiasis) *J Urol* Balt., 1945 54 39

The organisms producing bilharziasis of the bladder are the blood flukes, schistosoma hematobia discovered by Bilharz in 1851. They are small white worms belonging to the phylum platyhelminthes, and are sexually differentiated trematodes. Their home is, primarily in the vesical venous plexus of man. Here the male, a short, somewhat flat worm measuring from 10 to 15 mm in length and about 1 mm in breadth, mates with the female, which is more threadlike, and measures about 20 mm in length and $\frac{1}{4}$ mm in breadth. Each is equipped with two suckers, one at the proximal end and another on the ventral surface slightly caudal to the first. These suckers permit them to adhere to the venous walls, which avoids their haphazard dissemination by the flow of blood. The fertilized ova are deposited singly in file by the female along the courses of small submucous veins of the bladder. The eggs are deposited one directly behind another until no more space remains. This is then repeated from venule to venule, which not infrequently severely obstructs them. It is estimated that a pair of schistosoma hematobia may live as long as from 20 to 30 years, continuing this process throughout their lifetime. Eventually the eggs erode the wall of the venule and drop into the bladder cavity. Being free within the cavity of the bladder they are readily voided with the urine. To permit survival the ova must come in contact with fresh warm water immediately after voiding. From the ova, a miracidium larva emerges which, after a free life of about 6 hours enters a fresh water snail and seeks out the snail's liver where it passes through a sporocyst stage multiplying many times in number through a budding process, and then emerges from the snail as forked tailed larvae or cercariae. As cercariae, they swim about freely in the water and must find a human host within 48 hours in order to survive. With suckers, they attach themselves to the human skin, shake off their tails and burrow through. Entering the blood vessels, they eventually find their way to the liver where they grow to adult male and female. After attaining maturity they migrate to the vesical venous plexus where they mate and egg laying occurs, thereby completing the cycle.

The symptoms of bilharziasis of the bladder may be divided into four stages. In the first stage symptoms of skin irritation occur at the site of entry of the larva. These may be slight to severe pruritus and may completely escape the patient's attention.

During the second stage, generalized toxic symptoms may occur. The time interval is from 4 to 12 weeks after exposure. Again, these may be so slight as to not require medical aid. However headache, backache, and chills and fever with night sweats are the symptoms of which the author's patient complained upon his first hospitalization and they correspond to the migration of the parasites and the first egg laying by the females. At this time, the blood shows a leucocytosis and high eosinophil count. Not infrequently the abdomen is tender and the liver and spleen are palpable.

In the third stage, symptoms of bladder irritation become prominent. There is urinary frequency, dysuria, and hematuria. Ova are now found in the urine. This stage corresponds to the bladder condition observed by the author in his case at the cystoscopic examination a confluent papillarylike growth was found to cover the entire trigone. The areas surrounding the ureteral orifices were especially involved. Beyond the trigone on the posterior wall of the bladder three isolated areas typical of the trigonal involvement were present. This finding in the bladder could hardly be confused with a true papilloma because it was lacking in the fine villi and presented a deeper red to slight purplish color. The appearance was neither that of a papilloma nor of a bullous edema rather something midway between. Interspersed in the area involved were several discrete yellow to gray nodular masses.

The fourth stage corresponds to the symptoms and pathological changes encountered in its many varied forms from the time of the passing of the ova in the urine to the death of the patient unless treatment is instituted. During this stage, the bladder findings are typical of the changes encountered in long standing chronic bladder irritation. There is proliferation of the mucous membrane with subsequent necrosis ulceration and secondary infection. Secondary stones are common and phosphatic deposits frequently cover large areas of the inflamed bladder wall. Subsequent fibrosis and scar tissue occur. The bladder capacity is diminished, at times to the point of complete incontinence. With bladder fibrosis and contracture in which the lower ureter takes part ureteral obstruction progresses. Hydronephrosis, renal infection, anemia, and sepsis follow. The secondary pyogenic infection may extend through the bladder wall and urethra, producing perivesical and perineal abscesses with suprapubic and rectal fistulas. Elephantiasis of the genitalia due to interference with lymphatic drainage has been reported. A true papilloma stage has been reported. Malignant changes may occur producing the characteristic findings and symptoms, and to eventual death from papillary carcinoma of the bladder. In severe infestations, the prostate seminal vesicles are also frequently involved. Results in infections, abscesses and fibrosis of the organs. Ova have been found in the semen of cases. In women the disease is less frequent, vaginitis, cervicitis, ulcers, papillomas of the

and carcinoma of the bladder have also been reported.

Fairley's complement fixation test is said to give a group positive reaction during the latter part of the incubation period. At the present time, the diagnosis of bilharziasis of the bladder must await the symptoms and findings of bladder disease. Ova containing the characteristic terminal spine in the voided urine, the cystoscopic picture and biopsy of the affected bladder wall clinch the diagnosis.

The author's patient was treated with fusidin, a trivalent sodium antimony compound. It is administered intramuscularly in the dosage of 50 c.c. on alternate days after the first two injections of 15 and 30 c.c. given on successive days. A total of 400 c.c. is given over a period of 16 days.

The necessity of early diagnosis as well as early, proper and adequate therapy is absolutely essential if a complete cure is to be attained. Prevention of human infestation is, of course, the first and most important problem. In countries such as Egypt swamps and lakes have been drained the courses of streams changed vegetation laboriously removed from lakes and streams to starve the snail, the intermediate host and wholesale poisoning of the snails has been done, but without any noteworthy success. The fundamental approach lies in the education of the natives and in winning their co-operation in preventing themselves early for treatment.

JOSEPH K. NARAT, M.D.

Oppenheimer G. D.: Late Invasion of the Bladder and Prostate by Carcinomas of the Rectum or Sigmoid. *J. Urol.* Balt., 94:5 54 1935

Fifteen cases of late invasion of the bladder and/or prostate and seminal vesicles following abdominoperineal resection for cancer of the rectum or for obstruction due to sigmoid cancer are reported. Direct involvement of the lower urinary tract by cancer of the lower bowel occurs frequently in 50 autopsies of patients with cancer of the rectum, 20 per cent of whom had a rectal resection the bladder was found to be invaded 31 times. Bladder, prostate and seminal vesicle involvement in the male, and bladder and uterine involvement in the female, apparently takes place by direct extension. Twenty two of the 50 cases (44%) showed compression of one or both ureters. Metastases to the ureters or kidneys were uncommon. At least 10 per cent of the patients who survive abdominoperineal resection have late involvement of the bladder, prostate, or seminal vesicles.

Palliative urological or surgical measures and radiotherapy should often be attempted even after lower urinary tract involvement because life may be prolonged this was shown by 2 reported cases. In one an obstructive sigmoidal resection was performed for infiltrating adenocarcinoma after preliminary cecostomy 4 years later cystoscopy was performed for hematuria, and a 1½ cm. postero-superior bladder tumor was fulgurated two years later another tumor reported as adenocarcinoma

was fulgurated. The second patient had a transurethral resection of recurrent adenocarcinoma involving the bladder neck and prostate, 7 years after abdominoperineal resection and radiotherapy. Histologically the transurethrally resected tissue was definitely secondary to direct extension from the residual rectal growth.

The results obtained justify attempts to undertake radical surgery even though the local lesion is fixed to the surrounding structures, and also justify late palliative urological therapeutic efforts.

DAVID ROSENBERG, M.D.

GENITAL ORGANS

Greene, L. F., and Thompson, G. J.: Transurethral Prostatic Resection in Patients with Advanced Renal Insufficiency. *J. Urol.* Balt. 94:5 54 1935

Transurethral prostatic resection can be performed safely in the presence of advanced renal insufficiency and suprapubic cystostomy preliminary to prostatectomy is no longer considered necessary. By means of transurethral prostatic resection free urinary drainage through the natural urethral channel can be quickly and safely restored.

Fifty four case reports are presented, in which transurethral prostatic resection performed in the presence of severe renal insufficiency is described. The blood urea was well above 100 mgm. per 100 c.c. in every case and resection was performed a bench blood urea, although reduced, still remained 100 mgm. or more in the large majority of patients the urea was higher than 150 mgm. per 100 c.c. of blood, and in almost half it was more than 200 mgm. per 100 c.c. The youngest patient was 49, and the oldest 79. Fourteen patients had severe hypertension, and 10 had cardiac disease. Profound acidosis was present in every case. In practically every case the urine specific gravity was fixed and less than 1.015.

Preoperative treatment consisted of urethral catheter drainage, the intravenous administration of fluids so that the daily urinary output was between 5,000 and 3,000 c.c. the intravenous administration of sodium lactate or bicarbonate for acidosis, and blood transfusions for anemia. Treatment was continued until the blood urea and the carbon dioxide combining power were stabilized, which was the optimal time for operation. In more than two-thirds of the cases the necessary preoperative preparation was completed within two weeks.

Prostatic resection was usually performed under spinal anesthesia, and occasionally under pentothal sodium. In more than half of the cases it was necessary to remove more than 30 gm. of prostatic tissue in order to relieve the obstruction completely. Frequently the prostate glands were small when they were most obstructive and this has led to failure in the diagnosis in a number of cases in which the patients' complaints were of nausea, vomiting and anorexia. Particular care should be taken to remove all of the obstructing tissue.

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Of the 54 patients, 1 died of coronary occlusion 2 days postoperatively. More than half of the patients were able to leave the hospital within 2 weeks. The instillation of 1 750 solution of gentian violet into the bladder was the most effective method of stimulating the return of vesical tone. In some patients, when the blood urea had remained stabilized preoperatively in spite of further drainage and intravenous fluids, resection resulted in a fall of the urea concentration of the blood.

Follow up on 45 patients showed that 29 were alive and 16 were dead at the time of the report. Of the 29 alive, 2 in 2 years, 2 in 3 years, and 15 in less than 1 year. Of the 16 dead, 2 in 3 years, and 14 in less than 1 year. Of the patients who remained in from 5 to 8 years. Of the patients who lived at present, more than half have lived three or more years since resection. Although many patients had gastrointestinal symptoms prior to resection none of them has had a recurrence.

Transurethral prostatic resection can be performed on patients with advanced renal insufficiency with minimal risk, and the surgeon should not hesitate to perform resection in cases of this type. It has resulted in great economic advantage to these patients. Thus transurethral resection has provided surgical relief of patients suffering from prostatic obstruction and renal insufficiency.

DAVID ROSENBLUM, M.D.

W. H. Asepsis in Prostatectomy *Brit J Surg* 1945 33 41

In an effort to devise a technique of prostatectomy with an asepsis emulating that of other surgical procedures, the author has experimented with various possibilities in the cases of more than 600 patients during a period of about 6 years. The present study however is based on only the last 300 patients of the series after the experimental period had passed and the methods had become more or less fixed. In this technique, the author repudiates all use of the catheter or indeed of anything passed through the urethra. If it is necessary to relieve stress in acute retention he believes that the bladder should be punctured suprapubically with a spinal puncture needle. All manipulations are carried out suprapubically the bladder is decompressed at once and the full prostatectomy is then carried out in the normal way. After the prostate has been enucleated meticulous hemostasis is provided by means of a hemostat to which is attached the diathermy cable, deep bleeding being rendered accessible by the commonly advocated removal of the V-shaped, or semicircular, portion of the trigone by means of a "live" needle held in the jaws of the hemostat. Any blood clots are removed by suction and not with a swab. A couple of ounces of 5 per cent sodium citrate solution will prevent further clots in the prostatic bed and bladder.

A rubber tube is then passed from the bladder through the urethra in a retrograde fashion with the attached remnant of the prostatic urethra as a guide. To pass this tube the distal end is tied to a black French bougie with its bulbous proximal end

cut off. The rubber tubing and bougie are well covered with acriflavine-vaseline, which it is hoped will act as a pack around the tube within the urethra. The bladder should be securely and completely closed after which it is suctioned to evacuate citrate, air and any blood clot the last being rare. From 2 to 10 oz of sodium citrate solution are left in the bladder and a spigot is inserted. This spigot is removed about two hours after the operation and the tube is connected with further sterile tubing and let into a sterile Winchester bottle of sterile water.

It takes from one day to one week for the urine to become clear but if the clearance is delayed for more than 3 days infection must be suspected. Hematuria not requiring interference occurred in this series of cases in the author's opinion this indicates cystitis.

The operation is done under low spinal anesthesia and the patient is out of bed every day after the operation if only for a few minutes. Chemotherapy, which consists of not more than a half gram of sulfamethazone or sulfathiazole every 6 hours, is stopped on the fourth day but is renewed with the greatest intensity at the slightest sign of sepsis.

With this method (roughly outlined here for the purposes of this abstract) the author procured results which are characterized as startling. The more so as during the period of this series of operations only 335 cases of definite prostatic obstruction were seen. The surgeon refused to operate in only 6 instances in 5 patients the condition was sarcomatous. In the other patient the condition was sarcomatous. Twenty nine of the 335 patients refused operation or went elsewhere, and 300 were operated upon.

For the purpose of analyzing the mortality the material is divided into four groups. Group 1 consisted of patients in whom there was no marked systemic disease. In this group the residual urine at operation was 6 oz. or under indigo-carmin urine was passed through the urethra in less than 10 minutes and the urine was normal usually acid, and the blood urea 50 or under. This group included 189 patients with 4 deaths.

Group 2 included patients with mild systemic disease an indigo-carmin output in 15 minutes or less, a residual urine of under 15 oz. and a blood urea of 80 or under. The urine was often infected sometimes the pyuria was marked. In this group 31 prostatectomies were done, with 5 deaths.

Group 3 included patients with marked systemic disease usually cardiovascular. The residual urine ranged from 1 to 5 pints the blood urea commonly varied between 80 and 200. In this group were 31 operations with 5 deaths.

Group 4 was made up of those patients who had blood urea of over 200 and who showed evidence of cardiovascular failure, with edema, uræmic anemia or vomiting. This group (expressing an attempt to find the limit of aseptic prostatectomy) included only 6 patients, with 4 deaths.

Thus there was a total mortality for the 300 patients of 6.0 per cent. This mortality cannot of

course be compared with previous figures for this operation because of the lack of figures in other statistics with reference to the preoperative mortality with suprapubic drainage or with the indwelling catheter that is, septic prostatectomies. However a comparison can be had with the former results obtained by the author in that the present mortality is probably about one-fifth of what it was 6 years ago.

JOHN W. B. LEWIS, M.D.

Barnes J. L.: Teratoma of the Testis; Report of 65 Cases. *Am. J. Surg.* 945 54 257

Teratoma of the testis was observed in 65 patients during a 33 month period. These cases made up 7.86 per cent of all the malignancies admitted to the author's hospital. The average age of the patients was 28 years.

The cause of testicular tumors is unknown. It is thought that abnormal development, especially ectopic or undescended testes, may be a factor. This was present in 3 of the 65 cases. Trauma was mentioned in 21 instances, but apparently the trauma served only to direct attention to the tumor. Trauma as an etiological factor is still disputed.

Early diagnosis is of prime importance. Twenty-seven (41.5%) of the 65 patients were treated for other conditions before a malignancy was suspected. (The rapidity of the development of metastases in teratomas is unbelievable at times. The abstractor recently saw a patient who was treated for a hydrocele. The chest film was negative. In less than 1 month the patient developed a large liver which filled the epigastrium and the chest film revealed numerous metastatic depositions throughout both lung fields.) Forty-five of the patients (69%) had painless swelling. 24 (37.5%) complained of pain and 6 (9%) complained of a feeling of heaviness or dragging. Three-fourths of all the patients were treated within a year of the time the tumor was noted.

The history and course of the condition may be suggestive of testicular tumor. A smooth rapidly growing mass, inguinal adenopathy, neuralgia, tenderness to palpation, and nontransillumination to light are a few of the diagnostic findings. Teratomas must be differentiated from epididymitis, hydrocele, hematocele, gumma, and tuberculous and chronic orchitis. If there is doubt as to the diagnosis, a surgical exploration should be performed. Most of the tumors were found to be of the embryonal type, adenocarcinoma, or embryonal carcinoma.

Treatment consisted of a combination of surgery and irradiation. The surgery was radical orchiectomy and when possible, it was followed by irradiation on the third to fifth day. The cases were divided into those with no metastasis or with symptoms of less than 6 months and those with metastasis or with symptoms for longer than 6 months. In the first group the operative site, midabdomen, epigastrium, posterior sacrum, abdomen, and flanks were treated. In the second group in addition to the aforementioned fields, the lateral abdomen,

chest, and supraclavicular region were also treated. The following factors were used: 220 kv p., 15 ma., 50 cm. target skin distance from 0.5 to 1 mm. of copper plus 1 mm. of aluminum for filter, and from 200 to 250 r per each of two ports daily for a total dose of between 1,600 and 3,000 r per port.

A careful follow-up was made and after 33 months only 7 of the 65 patients who had been treated had died. The others were living and well.

MAURICE D. SUGGS, M.D.

MISCELLANEOUS

Forrythe W. E., Jr., and Karian, S. C.: Enuresis in Young Male Adults. *J. Urol.* Balt. 945 31

All cases of enuresis warrant complete study. A history is taken and specific urological questions are asked. The physical examination and laboratory investigation are routine. The patient is then placed under the joint observation of the urologist and the neuropsychiatrist. The former has excretory urograms made and performs cystoscopy and such other urological procedures as appear indicated. The patient is examined both neurologically and mentally. A cystometric study is then made and studied in detail. Emphasis should be placed on the importance of cystometry in the study of enuresis. By this means intravesical pressure changes which are produced by detrusor tone or activity in response to the introduction of known amounts of fluid are observed. Correlated with this is a sensory analysis. The authors prefer the use of a modification of the Munro water cystometer.

The following components are observed:

1. Sensation
2. First desire to void
3. Capacity. This is normally from 350 to 450 cc. and, as expected, varies with the reflex arc.
4. Intravesical pressure curve
5. Uninhibited contractions
6. Initiation of urination
7. Residual urine.

The following classification of the causes of enuresis therefore seem quite logical: (a) organic, congenital or neurological, and (b) functional.

The treatment of enuresis is based primarily upon making a correct diagnosis. It is quite obvious that attempted psychotherapy is time wasted when the true cause is organic. In cases in which local therapy is discovered, eradication of this process is usually followed by cessation of the symptoms. The good results which follow urethral dilatation, silver instillation, and vesical lavage may have been due in many instances to the inadvertent treatment of the local pathology.

The treatment of neurological cases remains very difficult. In addition to the old remedy of limitation of fluids, parasympathetic depression may aid in reducing the uninhibited contractions. In general, it has been found that these cases at best respond slowly to therapy.

JOHN A. LOER, M.D.

GENITOURINARY SURCFKY

Free, A. H., Huffman L. F. Trattner H. R. and Brown H. B. Oral Penicillin in the Treatment of Gonorrhea. *J Lab Clin. M.*, 1945 30 738.

All of the patients in the authors series were diagnosed as having gonorrhea by means of positive cultures, clinical signs, symptoms, and history. The penicillin used was in the form of a dry powder contained in gelatin sleeve capsules. Each patient in the study received a total of 1,600,000 units of penicillin over a 2 day period. The dosage schedule required that 100,000 units be taken every 2 hours during the waking period. Two urethral cultures in the male patients and 2 urethral and 2 cervical cultures in the female patients were obtained during the 10 day period following treatment, and in most of the patients a third culture was obtained at a somewhat later time.

Altogether 14 patients with gonorrhea were treated by the technique described. In all instances only negative cultures were obtained following the treatment, and all of the clinical signs and symptoms of gonorrhea disappeared.

JOHN A. LOFF, M.D.

Cutting, W. C., Halpern R. M. Sultan E. H. Armstrong, C. D. and Collins, C. L.: Penicillin by Mouth for Gonorrhea. *J Am Med Ass* 1945 129 425

Extensive trials of the administration of penicillin by mouth, with various enteric coatings and adjuvants to protect the penicillin or promote its absorption, resulted in the following useful combinations: mixtures of penicillin with tri isopropanolamine, trisodium citrate, or sodium carbonate enclosed in a resin-cellulose plastic enteric coating.

When the dose of penicillin was 50,000 units, administered every 2 hours for 10 doses these superior combinations produced penicillin blood concentrations of from 0.02 to 0.05 unit per cubic centimeter.

Fifty three cases of acute gonorrhea were treated with several of the most promising combinations, with cures in 38 or 72 per cent.

Treatment of infections with highly susceptible bacteria by orally administered penicillin appears to be feasible.

JOHN A. LOFF, M.D.

Dyar R., Scholtz, J. R. and Hammond, E. C.: Penicillin Treatment of Previously Untreated Acute Gonorrhea. *Am J Syph.*, 1945 29 563

Four hundred and ninety-eight patients with previously untreated acute gonorrheal urethritis were treated with penicillin. Eighty three per cent of those treated with 50,000 or 75,000 Oxford units were considered cured on the basis of negative smears and/or cultures thereafter. Ninety-one per cent of those treated with 100,000 units of penicillin at one of those treated with the same dose. All patients considered cured on the first treatment were subsequently cured by retreatment with penicillin. The proportion cured did not vary significantly with the duration of symptoms prior to the institution of

treatment. There were no treatment reactions of significance.

Cases responding to penicillin therapy showed early clinical improvement and were generally bacteriologically negative 24 hours after treatment. The validity of the criteria of cure used was established by the re-examination from 6 to 12 weeks after the last treatment observation of 119 of the individuals originally considered cured on the basis of 21 days of post treatment observation. Among the 119 cases selected at random there was a positive smear or culture after rigorous tests of cure, in only one case.

JOHN A. LOFF, M.D.

Lydon F. L. Trichomonas Vaginalis Infection in the Male. *Brit Med J* 1945 2 384.

The frequency of trichomonas vaginalis infection in the female has for many years been recognized but the similar infection in the male has not received the attention it merits, since it is by no means an uncommon cause of urethritis. During the past few years the author has seen numerous cases of this nature, some of which he was fortunate enough to observe over many months, and the results of his investigations are put forward in the hope that with a higher index of suspicion when confronted with urethritis especially one showing a tendency to relapse and chronicity other workers will discover that many of the cases are due to infection with trichomonas vaginalis.

As for all chronic conditions especially when subject to remissions there are a multiplicity of cures. It is the author's opinion that, at this time there is no specific treatment for the condition although many methods have been advocated to bring about amelioration of the signs because the propensity to relapse is similar to that in the female even when no further exposure is possible. It is essential, therefore, to prolong surveillance over many months. Recently the administration of mepracrine hydrochloride, both in the usual dosage and by the intensive method now employed for malaria has been tried, but although the discharge decreased to a very slight amount and the active organism disappeared from the discharge the tell tale resisting cell could still be found on careful search. This drug may prove a failure too when subjected to the test of long surveillance.

JOHN E. KIRKPATRICK, M.D.

Lehr D.: Experimental and Clinical Studies with Sulfacetamide (p-Aminobenzenesulfonamide): Toxicity and Efficiency in Bacillary Infections of the Urinary Tract. *J Urol* Balt. 1945 54 87

Comparative studies of the acute and chronic toxicity of the sodium salts of sulfacetamide sulfadiazine and sulfanilamide have been carried out in albino rats by the intraperitoneal route of drug administration.

Figured on the basis of the medium lethal dose (LD50) sodium sulfacetamide possesses by far the

lowest acute toxicity being about five times less toxic than sodium sulfadiazine and more than seventeen times less toxic than sodium sulfanilamide. Based on mean values of the highest blood levels reached with fatal dosages of the three sulfonamides the relationship of the acute toxicity of sulfacetamide, sulfadiazine and sulfanilamide is as 1 to 3 to 10. (This relationship is expressed for equal weight amounts of the respective sodium salts.)

The chronic toxicity of sodium sulfacetamide is likewise lower by far than the toxicity of sodium sulfadiazine. At a daily dosage level of 0.6 gm. per kgm. body weight continued over a period of 9 weeks, sulfacetamide caused no significant pathology, anatomical lesions. The equimolar amount of sulfadiazine (0.7 gm per kgm.) however invariably produced severe organic damage particularly in the kidneys and in many instances also in the aorta.

The mechanism of the nephrotoxic action of the sulfonamides was discussed. The low renal toxicity of sulfacetamide was explained as being due to its high solubility (in water sulfacetamide is about 115 times as soluble as sulfadiazine) which apparently precluded the serious consequences of massive and long-lasting intratubular deposition of crystals which occurred from sulfadiazine.

The ready absorption and rapid renal elimination of sulfacetamide as well as its high solubility particularly in urine made it possible to obtain high urine concentrations in the presence of relatively low blood levels.

In *in vitro* antibacterial experiments it was found that sulfacetamide exerted a powerful effect against *Escherichia coli* communior even if very large inocula were used.

In comparative studies of sulfacetamide sulfathiazole and their succinyl derivatives using a streptococcus strain freshly isolated from a patient with infection of the urinary tract sulfathiazole proved significantly more effective than sulfacetamide in low concentrations (5 to 10 mgm. per cent) whereas in concentrations generally obtained at the bedside under routine treatment (50 to 110 mgm. per cent of the free drug) there was little difference in the antibacterial effect of the two compounds.

Conjugation with succinic acid at the para-amino group decreased the bacteriostatic activity of both compounds very markedly.

The results of these experiments suggest that from a pharmacological and toxicological standpoint, sulfacetamide deserves preference over other sulfonamides now in use for the treatment of infections of the urinary tract.

JOHN A. LOFF, M.D.

Keyser, L. D.: Studies in Urinary Calculosis. *J Urol Balt.*, 1945 54 94.

The author has tried to fit together some of the evidences of the origin of urinary calculi from the physicochemical, bacteriological and pathological standpoints as revealed by animal experimentation and the study of stone-forming kidneys. He presents the concept of a stone-forming pyelonephritis

which parallels in some degree that of other types of crystalline deposition in tissue.

Among the contributions of our generation to stone research, four are outstanding.

1 The demonstration of lithiasis in vitamin-starved animals.

2 The experimental production of stone in animals by excessive excretion of crystalloids such as oxamide, calcium oxalate and calcium carbonate, with later clinical confirmation of such a hyperexcretory mechanism in hyperparathyroid disease, in gout, and in certain unexplained hypercalcaemias.

3 The production of calculi in animals with type-specific bacteria.

4 Tracing of the morphogenesis of aseptic stone arising on calcium plaques or in crystalline clogged pyramidal tubules.

The implication of each of these different approaches remains intensely controversial as a demonstration of a single cause of stone. The author believes that we must revert to the concept that calculus formation is one and only one of many types of crystalline deposition or lithification in tissues. In other words, urinary calculus is not a disease entity but represents a variable physical form of concretum building which may result from equally variable conditions.

Physical chemists teach us that crystalloid-collod aggregates arise when water insoluble crystalline matter is deposited in the fibrillary mesh or organic colloids which are proceeding from the state of sol to that of irreversible gel. The electrodynamic surface action of colloidal matter is of great magnitude and as crystals are caught in the interstices of geling colloids, they undergo changes in form and in polarity with rearrangement internally. This results in a variable increase in density and to some extent determines the ultimate form which the crystalloid-collod aggregate is to assume. Again, this secondary internal crystallization dependent on surface interaction of the forming concretum, determines the lobulation, lamination, Liesegang ring formation, the roughness or smoothness of the surface, the variable densities of surface and inner areas of the stone, and perhaps the size of the concretum itself. The contour of the calculus is, of course, modified by the contour of the calyx or pelvic wall to which it was originally attached. However the electrochemical surface interaction of forming concretums is of the greatest importance even in this respect. Such a physicochemical concept of concretum building explains the polymorphism of stones seen clinically.

Outstanding among the efforts at dissolution of urinary calculi are the use of acid irrigating solutions, such as dilute aqua regia and phosphoric acid, the use of acidifying drugs and diets by mouth, the production of so-called hydrotropic substances in greater concentration in the urine, as in the use of sodium benzoate and glycocholic acid to form hippuric acid by Snapper, Bendien, and Pollak, and the application of calcium-dissolving chemicals such as Al-

GENITOURINARY SURGERY

bright a citric acid sodium citrate solution and Snby's solution of magnesium acid-sodium citrate. The latter seems most popular at present. The reported cases of dissolution or partial dissolution of stone for the most part represented dissolution of soft, pultaceous, calcareous material. However in many roentgenograms illustrating stone disintegration following these techniques few show complete dissolution. Nearly always some calcareous material remains. After a 10 year experience most dissolution techniques have been disappointing. The author has had opportunity to try urinary acidification with intense Vitamin A feeding diets, and drugs. Continuous or rapidly repeated irrigation of stone-bearing and frequently infected kidneys with nephrostomy tubes nephrostomy tubes above and ureteral catheters below tidal irrigators Y tube irrigators, and hand syringe techniques have been used. They are time-consuming and sooner or later lead to renal irritation fever and pyelitis. After all of them were tried the use of the simple Y tube irrigator controlled by the patient with a No. 10 F indwelling catheter has seemed as good a method as any. Tidal irrigators do not work in the renal pelvis with the Munro Nesbit Webb, Snby or other setup. At best, any irrigator must be attached for a number of days or possibly weeks.

When possible stones should be removed surgically or cystoscopically. Residual material or

rapidly reforming calcification may be removed by irrigation. Of the solvents, Snby's solution G is perhaps the best although it too has been only rarely successful.

As stated above soft calcareous material and at times, softer stones can be dissolved. Hard dense calculi of any composition, and especially those with laminations the oxalate and urate stones, defy dissolution by any method used at present. The dangers of urinary acidification especially when prolonged and maintained over long periods of time with ammonium chloride and nitrate are well known. This procedure may even cause stone formation to become more intense. It is therefore the author's practice to apply stone dissolution techniques for a short period of two or three weeks. If they are not well tolerated the regimen is stopped.

The author concludes that our present approaches to stone dissolution are unsatisfactory and the immediate future does not look particularly promising. For this reason, dense calculi those of oxalate and urate composition had better be removed surgically if possible. Efforts at eradication of non removable calculous material should be approached most conservatively with dissolution techniques. Efforts at dissolution of irremovable stones, such as bilateral staghorn calculi which cannot be successfully attacked by the improved extended pyelotomy techniques will rarely be successful.

JOSEPH K. NARAY, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Sheldon, W. H., Thebaud, R. R., Hayman, A. and Wall, M. J.: Osteomyelitis Caused by Granuloma Inguinale. Report of a Case with Cultivation of the Donovan Body in the Yolk Sac of the Developing Chick Embryo. *Am J M Sc* 945:11-137.

During the past year several cases of systemic dissemination of granuloma inguinale have been reported. In this article the authors present the history of a patient in whom hematogenous dissemination of the disease seems to be certain.

A 43 year old colored male was admitted to the hospital complaining of pain and exhibiting a large ulceration on his left leg. His past history revealed that he had had a urethral discharge 20 years previously. This was associated with an inguinal bubo which eventually ruptured and drained for a while. Also about 18 years previously he had an ulcer near the frenulum which healed without treatment. At no time had serologic tests been made, nor had he received any treatment for syphilis.

On admission to the hospital the patient stated that about 6 months earlier he had struck his left shin against a heavy object. The leg was bruised and would not heal. Three months later he injured the same area and an ulcer developed. A month

later the left knee became stiff. Five weeks later a penile lesion was noticed by the patient for the first time. It consisted of a small erosion on the dorsum of the penis adjacent to the corona. He further stated that he had lost 45 pounds in weight in the last six months.

The examination showed an elevated granulomatous lesion measuring 7 by 15 cm. on the upper third of the left leg. A second band-shaped ulcer measuring 1 by 3 cm in width was found encircling the penis just proximal to the corona. There were no lymph nodes palpable in the left inguinal region. Some enlarged nodes were found in the right groin. The laboratory findings were normal except for the sedimentation rate (15 mm. per hour) serum alkaline phosphatase (4.6 Bodansky unit) positive Ducrey and tuberculin tests, and negative Kahn and Frei tests.

A lytic bone defect measuring about 4 cm. in diameter was seen on the roentgenogram of the tibia at the level of the tibial tubercle. The lesion was surrounded by sclerotic bone. Roentgenograms of the other bones were negative except for a cystic lesion measuring about 1 by 1.5 cm. in the anterior portion of the left rib. Biopsies from the granuloma tissue, bone, and bone marrow had the appearance of granuloma inguinale. Donovan bodies were isolated by inoculation of tissue material into a chick embryo yolk sac following the technique described by Anderson. Biopsy of the rib lesion did not resemble granuloma inguinale on histological sections.

The treatment consisted of local application of sulfadiazine and tyrothricin. Fluidin was given intramuscularly at weekly intervals. The tibial defect was packed with iodoform gauze and the packing was changed at frequent intervals. A split thick



Fig. 1. The large granulomatous lesion of the left leg. Note the deep ulceration near the upper edge of the lesion which extended into the marrow cavity of the tibia.



Fig. 2. Roentgenogram of left tibia, lateral and anteroposterior view. Large defect in the tibia with some sclerosis of the surrounding bone and irregular periosteal thickening.

ness graft was applied to the lesion of the leg 90 per cent of the graft survived

GEORGE I. REISS, M.D.

Sallouche, L. G.: A Study of Periscapulothoracic Calcifications (Contribución al estudio de las calcificaciones periscapulothorácicas). *Cirugía y apar. locomotor* 1945 2 239

Periscapulothoracic calcifications are an anatomical form of the periarthritis described by Duplay. They may be acute or chronic. In both the acute and chronic forms the symptoms are pain and rigidity of the shoulder. In some cases there are no symptoms at all. These calcifications are generally located in the subdeltoid and subacromial serous bursae or in the tendon of the supraspinatus muscle the latter localization being the most frequent. They consist essentially of a local calcification caused by an inflammation of the serous bursae which may be due to syphilis or rheumatism or by necrosis of the tendon due to trauma. There is rarely if ever a single severe trauma but usually rather slight and frequently repeated postural or occupational minimal trauma due to pinching of the tendon of the supraspinatus muscle between the head of the humerus and the acromioclavicular process.

The treatment of these calcifications is the same as that of the other forms of scapulothoracic periarthritis. The treatment of choice is infiltration of the stellate ganglion with an anesthetic the author has had good results from the infiltration of procaine followed by the injection of from 2 to 3 c.c. of a 1 per cent solution of novocain. Physical methods such as diathermy infra red rays, radiotherapy and mechanotherapy may be used as adjuvant treatments. If infiltration of the stellate ganglion fails, which has never occurred in the author's experience, forced mobilization should be carried out under anesthesia. Surgical operation is rarely indicated.

The literature on the subject is reviewed and histories and roentgenograms of 7 cases are given.

AUDREY G. MORGAN, M.D.

SURGERY OF THE BONES, JOINTS MUSCLES, TENDONS, ETC

Hellatadius, A.: Bone Chip Grafts in Defects of the Long Bones. *Acta chir scand.*, 1944, 90 317

In some cases of bone transplantation the use of bone chips has proved better than the use of a single large bone graft. For instance, in Albee's operation for tuberculous spondylitis some surgeons have used bone chips in place of the single transplant. Matti believes that the bone chips are more resistant than the large graft to infection in the field of operation.

In this article experiments on rabbits are described in which chips of compact bone (with the endosteum and periosteum) were placed in a defect in the diaphysis of one radius while chips from spongy bone substance were placed in a corresponding defect in the diaphysis of the other radius. On the side on

which compact bone was used new bone was formed more quickly and in larger amounts than on the side on which spongy substance was used and the differentiation of marrow and cortex took place more rapidly.

In some cases the soft parts around the bone showed a tendency to grow in between the spongy bone transplants. It would seem, therefore that chips from compact bone are preferable to those from spongy substance in repairing defects in the long bones.

Matti advocated the use of chips of spongy substance in these cases as he said that the bone cells in the spongy grafts survive while those in the compact grafts do not. This opinion was not confirmed in these experiments.

Further experiments were made to determine the relative value of chips of cortex freed from periosteum and endosteum and chips in which the periosteum and endosteum were retained. Grafts of this kind were inserted into defects in the radius and also into the soft parts around the bone. The experiments showed that new bone is formed more readily when the periosteum and endosteum are retained.

AUDREY G. MORGAN, M.D.

Oldfield, M. C.: Iliaic Hernia after Bone Grafting. *Lancet* Lond., 1945 248 810

On 56 occasions, bone grafts taken from the ilium were used in the repair of defects of the face and skull. One patient developed a Landolt type of hernia of the cecum into the donor site. When the patient was standing a protrusion was noticed in the right flank. The hernia was easily reducible. The hernial orifice was about 1 1/4 inches in diameter and the protruding cecum measured about 3 1/4 inches in its greatest diameter. Repair was done under spinal anesthesia and fascial sutures were used. The fascial strip was taken from the right thigh by means of a Masson's fasciotomy.

The patient was kept in bed for a period of 4 weeks, and during the last 2 weeks graduated abdominal muscle exercises were done. He returned to work and suffered no disability.

GEORGE I. REISS, M.D.

Strange, F. G. S.: The Major Amputation Stump in Health and Disease. *Brit. J. Surg.*, 1945 33 51

The ideal amputation stump is regarded by the author as a smoothly contoured and somewhat tapering cone, well balanced, powerful, with full range of movement, and well re-educatable muscles and of ideal length (as recently described by Kelham and Perkins—*Amputations and Artificial Limbs* London: Oxford Univ. Press 1942). The skin over this stump should be snugly fitting, underlain by its own deep fascia healthy and meeting at a mobile, linear and usually terminal scar.

These requisites will best be attained by the avoidance of trauma at operation, all structures being simply cut through and not subjected to crushing or injections of alcohol as was formerly

done in the case of the large nerve trunks. However a densely adherent nerve end bulb is not necessarily a painful one. The periosteum is cut through level with the bone end. This is almost invariably the site of a spur which must be recognized as a normal constituent of an amputation stump.

Avoidance of infection has also been given much thought however of all the operations designed to heal by first intention, amputation falls most often. Of the 406 cases forming the basis of this report, 332 (81.7%) amputated for a shorter or longer period before healing and this included 79 consecutive cases treated by the author himself with primary healing in 63 (80%). In a clean case, such as the reamputation in which operation can be delayed for several weeks primary suture is permissible. It may also be used in the presence of a septic process, when this process is comparatively remote from the intended site of amputation, when it is of long standing, or when it has not yet developed completely. If however at the time of removal of the tube in 48 hours, there is evidence of infection, the wound must be reopened and the flaps turned back. The delayed suture technique of Jack and Chamley (*British Orthopaedic Association Meeting* Rochester, 1943: 131) is mentioned as an improvement—15 cases healed by first intention, 14 healed with soft tissue infection only, and 3 cases presented severe infections—but still it fell short of the ideal result sought. Secondary suture is performed after 14 days of open drainage of the amputation wound.

There remains, however a proportion of cases in which the infectious process is too close or too acute for any reasonable hope of primary healing following the use of any of the described methods. In these cases the first aid amputation is applicable this is a very low amputation in which some degree of infection is expected, but which allows plenty of room for reamputation when the sepsis has been controlled. The remaining method is the guillotine amputation, which because of the lack of flaps can be carried out very close to the lesion if necessary and thus allows as much room as possible for subsequent reconstruction.

The postoperative management of all the amputations, except the guillotine, was the same: that is, a drainage tube and gauze dressing with tight elastic bandage enveloping the entire stump, were used, and a posterior or other splint was applied for 12 days to forestall subsequent flexion contractures. The drain was removed after 48 hours, and the sutures on the twelfth day no daily dressings, probing or squeezing were resorted to for removal of the hematoma. Nonresistance exercises were begun after 12 days and resistance exercises after 3½ weeks. The stump was ready for limb-bearing after from 4 to 6 weeks.

In the guillotine type of amputation a Bunyan Stannard envelope (*Brit Med J* 1941: 1) is applied and after irrigation with hypochlorite, light skin traction in a Thomas knee splint or Jones humerus extension splint is used on occasion a Thiersch

graft is applied as soon as the bone end is covered by granulations. This method is applicable to the stump which breaks down and leaves an open wound. The striking thing about this Thiersch graft is that it often shrinks down to where it may later be excised with subsequent approximation of the previously nonapproximating skin edges.

In the author's material (406 cases) there were 104 reamputations: these operations are indicated for completion of the two-stage amputations for certain types of adherent scars, for repeatedly identifying scars when there is not enough skin to allow excision and suture, and when there is no stump tolerance of the vascular type. However these operations should wait until the amputation stumps have been healed for 6 weeks. To perform reamputation in the presence of an open wound is a violation of the basic principles of surgery and cannot be condoned even when associated with the use of the sulfonamides or penicillin. JOHN W. BRIDGES, M.D.

FRACTURES AND DISLOCATIONS

Soto-Hall, R.: Fractures of the Carpal Scaphoid. *J Am M Ass* 1943, 129: 235.

The treatment of recent fractures of the carpal scaphoid is almost a solved problem, as has been shown by the many studies of end-results in the last few years; however the author believes that too many surgeons fail, either because they are not vigilant in noting and following the most minute details in diagnosis and treatment or because they experiment with methods which are not founded on sound anatomic principles.

Fractures of this type must be diagnosed immediately after the injury and failure to do so is one of the main causes of nonunion.

The history of a fall on the outstretched hand, tenderness in the anatomic snuffbox, and pain at the point on percussion of the fully extended thumb should be almost conclusive evidence. Should the initial roentgenograms fail to show the fracture, the clinical findings should be used as presumptive evidence, and the only course to be followed is immobilization of the wrist for a period of 3 weeks. After this should radiographic studies again be negative, the patient a ligamentous injury will have been helped by rest, and if as so often happens the films show a bone injury he is already started in the proper path of healing.

Certain precautions in taking roentgenograms are desirable. For careful comparison with the uninjured wrist, lateral views should be taken with the two wrists in the same position, and this can best be attained by putting the palms together with the fingers pointing forward in a "praying position." The posteroanterior views must always be taken in complete ulnar flexion, as in this position the long axis of the scaphoid is visible and at least two obliques are needed to complete the study, with the palmar and dorsal surfaces of the wrist alternately next to the plate. Fractures involving a small part



Fig. 1 Experimentally produced fracture of the carpal scaphoid in a cadaver. A wire has been threaded through the flexor pollicis longus tendon. These views show the intimate relationship of this tendon to the scaphoid particularly to the area of the tubercle. In these specimens any movement of the interphalangeal joint of the thumb produces a definite change of position of the fractured fragments. The tendon passes beneath the transverse carpal ligament and enters the osseoponeurotic canal, of which the scaphoid is a wall then passes distally to be inserted in the distal phalanx of the thumb. Note that in the anteroposterior view the fracture is not visible whereas in the oblique view it is readily seen.



Fig. 2 Two views illustrating maneuver for manipulating the wrist into correct position of full radial flexion, so to 30 degrees dorsiflexion of the wrist with the base of the thumb in full abduction but its metacarpophalangeal and interphalangeal joints relaxed in slight flexion, the heel of the physician's hand pressing against the heel of the patient's hand.

of the proximal pole should be differentiated because in this type the blood supply is poorest and the prognosis therefore is least favorable.

Fracture of the tubercle offers little difficulty since the bone in this area is covered by periosteum and is well vascularized. This is a rare lesion. Full healing should take place in from 3 to 4 weeks by simple immobilization of the wrist.

In the treatment of fractures through the body, the first step should be to determine accurately whether any displacement is present. The lateral film should be carefully studied for angulation. In the presence of displacement reduction can be obtained by traction on the thumb while the snuffbox is molded by the surgeon's fingers. Once alignment has been attained, the fragments can be impacted and properly immobilized by placing the wrist in full radial flexion with from 20 to 30 degrees dorsiflexion and pressing the base of the thumb just below its proximal crease into full abduction.

Proper immobilization of the thumb is important because by its inclusion more complete fixation of the wrist can be attained and any active movement of the thumb involves the long flexor tendon and the abductor pollicis which, by its intimate relationship with the scaphoid produces motion of the fragments.

Care must be taken to force the thumb into abduction at its base rather than at its tip since the latter procedure leads either to strain or to subluxation of the metacarpophalangeal joint. In this strained position recovery of function takes place much more slowly. The metacarpal therefore should be abducted and the thumb relaxed in slight flexion.

An anterior skin-tight plaster splint is first applied and then one layer of circular flannel bandage is wrapped around the extremity. This is followed by

a circular plaster splint. It is important that the plaster be carried as close to the elbow as possible and still allow full flexion of this joint and as previously mentioned the plaster should extend to the middle of the thumb nail and to the metacarpophalangeal joint of the fingers. Mobilization of this area in scaphoid fractures will not produce the stiffness one always notes following Colles' fractures.

Immobilization should be complete and undisturbed for at least 6 or 10 weeks. A large percentage of fractures will heal in this time but a period of from 4 to 5 weeks longer may be necessary. Roentgenograms and clinical examinations should determine whether this further immobilization is desirable. The presence of local tenderness in the anatomic snuffbox, or pain on percussion on the tip of the thumb associated with inconclusive radiological evidence of union should warrant further immobilization. Sometimes the clinical evidence of union will appear before it is demonstrated in the roentgenogram.

Certain authors have recommended prolonged immobilization sometimes as long as from 12 to 18 months. The author does not concur with this policy, because 95 per cent of fractures will have united in from 4 to 5 months and when union is delayed beyond that time there are certain complications which should be treated surgically rather than by further splinting. These are malposition of the fractures, interposition of strong fibrous bands, aseptic necrosis, or an uncontrolled very small fracture of the proximal pole. In the latter injury in which only one-sixth of the scaphoid is involved an excision of the small fragment (if three months splinting fails) results in better function than very prolonged immobilization.

When fractures of the scaphoid are associated with luxation of the semilunar bone, which occurs in about 12 per cent of the cases, the wrist must of necessity be held in slight volar flexion for the first 4 weeks. If it is placed in dorsiflexion in order to treat the scaphoid fracture the semilunar may redislocate.

ROBERT P. MONTGOMERY, M.D.

Pendergrass, E. P., and Lafferty, J. O.: Roentgen Study of the Ankle in Severe Sprains and Dislocations. *Radiology* 1945 45 40.

Usually the interpretation of roentgenograms of the ankle is confined to the diagnosis of bone or cartilage lesions because it is based only on anatomical observations. The present article represents an attempt to employ roentgenography for the diagnosis of soft tissue lesions of the ankle by taking into consideration the physiology of this joint.

The authors noticed that multiple roentgenograms of a recently severely sprained ankle which was manipulated into different positions on the roving table showed an abnormal lateral rotatory mobility of the talus and a tendency of the talotibial joint to subluxate, whereas films of 6 normal ankles failed to demonstrate this phenomenon. After four weeks of immobilization this abnormality could no longer be demonstrated. (The case was complicated by an old ununited fracture of the internal malleolus which was thought not to have any bearing on this observation.)

The authors come to the conclusion that in cases in which conventional anteroposterior and lateral films of the ankle in neutral position fail to show any bone lesion, additional anteroposterior films should be taken with the foot held in forced inversion and eversion as well as in flexion and extension. This type of filming is also recommended for cases of recurrent painless ankle sprain, instability of the ankle, abnormal mobility of the ankle joint with a depression in front of the external malleolus and for cases which are to be given procaine injection treatments. The purpose of this examination is to demonstrate a tear or extreme stretching of the entire external lateral ligament, or at least of its anterior and middle fascicles. In simple sprains only the anterior fascia is involved according to Elmle. No x-ray findings are then to be expected.

Permission for the manipulation of the ankle necessary for this type of filming should be obtained from the referring physician. The injection of from 5 to 10 c.c. of procaine around the point of maximal tenderness prior to the examination is suggested for painful cases.

GERHART S. SCHWAB, M.D.

Cano, L. S., and Valdés, E. R.: Mechanical and Biological Problems in Nailing the Marrow of Fractured Bones by Kuentscher's Method (Los problemas mecánicos y biológicos del enclavamiento modular de Kuentscher). *Cirugía após locomotor* 1945 3 93.

The history of the method of inserting metal nails or pegs into the marrow cavity in fractures of the

long bones is reviewed. Various metals were tried but in 1940 Kuentscher described his method of using V-shaped inserts of stainless steel, which seems to be the best method so far devised. With the use of this metal there is no corrosion and immobilization is so complete that the use of plaster is not necessary.

This method fulfills the three requirements in the treatment of fracture that the fragments be accurately reduced, that they be immobilized in good position until consolidation takes place, and that the muscles and joints be exercised as much as possible during the immobilization of the fragments. It has been found that the presence of a large foreign body in the marrow cavity is tolerated very well and that the pressure exercised by the nail further calls formation. The marrow itself also plays a part, but not the predominant part, in callus formation. Callus formation takes place for the most part from metaplasia of connective tissue. The presence of the nail may stimulate callus formation by a process of chemical irritation and by stimulation of phosphatase production, although the authors have not been able to demonstrate the latter.

The blood picture usually shows a more or less marked eosinophilia and an increase of reticulocytes for some days after the insertion and removal of the nail. Experimental work has shown that some bit passes into the lungs but not enough to endanger the life of the patient. Infection is rare in these cases and when it occurs, it is mild.

The chief indication for the use of this method is in simple fractures of the diaphysis of the femur, especially in elderly patients in whom continuous extension or plaster casts are dangerous. It is also very useful in corrective osteotomies, in viciously consolidated fractures, and malformations of the joints. It is not so definitely indicated in compound fractures, gunshot fractures, and fractures of the tibia, humerus and forearm.

Thirteen cases treated by the authors are discussed, 6 being simple fractures of the femur; 1 a pathological fracture of the femur from metastatic carcinoma, 3 simple fractures of the tibia, 1 a compound fracture of the tibia, 1 a pseudarthrosis of the humerus, and 1 a pseudarthrosis of the radius.

AUBREY G. MORRIS, M.D.

Rodríguez, F. D.: The Surgical Treatment of Pathological Fractures (Tratamiento quirúrgico de las fracturas patológicas). *Rev. aspa. de cirugía ortopé.* 1945, 73: 17.

When fragility of bones is due to general causes and the whole skeletal system is involved the treatment is chiefly medical, but when bone disease is caused by localized infections or cysts the resistant fractures can be treated surgically. In such cases there is a localized rarefaction of bone and always a deficiency of protein. One of the principles of treatment is to remove the periosteum, together with fragments of cortex, of a normal part of the bone, and add these fragments to the blood clot which has formed at the site of the fracture. This provides a

medium for fixing the calcium phosphates and initiating regeneration of bone. Blood calcium is an important factor in osteogenesis.

Two cases are described the first in a young woman who suffered a fracture of the middle third of the left humerus merely from her husband taking her arm. The bone could be doubled back on itself at the site of the fracture without any pain. The roentgenogram suggested hydatid cyst and this diagnosis was confirmed by biological tests. The cyst was destroyed by surgery and for some days destruction of the parasites was continued chemically by means of a mild solution of formal introduced into the marrow cavity of both fragments through drains. When all the echinococci were thought to be destroyed hyperemic treatment was begun with short waves hot fomentations and Bier's passive congestion. During the days that this treatment was given the site of the lesion was irrigated daily with rivanol solution to maintain an acid reaction. When the roentgen and clinical pictures suggested that osteogenesis had begun, an alkaline solution was substituted for the acid one. (Mineralization of the protein substance is best brought about in an acid medium.) When osteogenesis was at its height a plaster cast was applied and the patient sent home. After 6 months she returned with a completely consolidated fracture and good function of the arm but the bone had healed in a vicious position.

The second case was that of a young girl 12 years of age with a cyst which was caused by localized osteitis. This case was treated by the insertion of a nail into the marrow cavity of the two fragments (Kuehntscher's method). The fracture was in the upper third of the femur. Fixation was perfect and

after a week the patient could move the joint, and after 25 days she was able to get up and walk. This treatment avoided the muscle atrophy and rigidity of the joint which is sometimes caused by prolonged rest.

The article is illustrated with roentgenograms of both cases and photographs of the second patient showing the excellent results of treatment.

AUDREY G. MORRAN, M.D.

ORTHOPEDICS IN GENERAL

Hertz, R.: Herniation of Fascial Fat and Low Back Pain. *J Am M Ass* 1945 128 931

The author reports the cases of 6 female patients with low back pain who recovered completely following the removal of a tumor in the low back region. The tumor consisted of a fat hernia through the superficial fascia in the lumbar and gluteal areas. In most instances histological examination of the excised fatty mass revealed fat lobules and some fibrous tissue. The blood vessels showed perivascular proliferation, thickened walls and congestion.

In many of the cases several nodes were palpable in the lower back region. Injection of 1 per cent novocain into the small hard masses alleviated the low back pain. Some patients complained of pain in the left or right leg associated with the low back pain and this pain also disappeared when the novocain injected into the nodes had localized in the low back region. All patients who responded favorably to the local injection of novocain had complete relief after the nodes had been excised.

Copeman and Ackerman report similar findings in 14 soldiers with back pain.

GEORGE L. REISS, M.D.

SURGERY OF THE BLOOD AND LYMPH SYSTEMS

BLOOD VESSELS

Crafoord, C., and Nylin, G.: Congenital Coarctation of the Aorta and Its Surgical Treatment
J. Thorac. Surg. 1915 14 317

It was demonstrated by one of the authors in an experimental study on dogs that the flow of blood to all the organs could remain suspended for as long as twenty to thirty minutes without any subsequent signs of organic damage provided an adequate flow of blood was secured. This circulation to the brain was maintained by creating anastomoses between the carotid and jugular vessels of an animal of the same size. On the strength of this observation Crawford in certain patients with a patent luctus arteriosus took the risk of placing clamps on the aorta at the level of the duct. Although in one of the patients this part of the operation took 37 minutes to perform, no noticeable disturbances were observed in the patient's internal organs.

The question arises as to whether it might not be possible to treat congenital coarctation of the aorta by a purely surgical means. Coarctation of the aorta is a fairly common abnormality and knowledge of the congenital defect really has accumulated in the last few decades. The anomaly has been known for nearly 200 years. In her classical work on congenital cardiac disease Abbott found 132 cases among 1,000 cases of congenital cardiovascular defects.

The constriction of the aorta is localized just below the insertion of the duct arteriosus. The narrowing may be very slight or there may be complete obstruction of the aorta. The aorta is not usually dilated above the constriction but the part proximal to the obstruction may be thin walled and hypertrophied. The descending aorta is of the same size as the upper portion but very often it is partly obliterated. The deformity is often associated with other cardiovascular anomalies such as bicuspid aortic valves. Anomalies of the aortic arch are frequently found.

Coarctation of the aorta in its classical form is easily recognized. The most important sign is the increased blood pressure in the upper part of the body. Some cases of coarctation may occur however with normal blood pressure in the arms. Every young person with hypertension should be examined at first to find out if he has a coarctation. If he has no pulsations in the popliteal artery or if the blood pressure is lower in his legs than in his arm then it should be realized that there may be coarctation. In general the average age at death in Abbott's series was 32 years.

The authors report 2 cases, one of a 12 year old boy and the other of a 27 year old farmer both of

whom were operated on to relieve congenital coarctation of the aorta. The details of the findings before and after the operation are presented. In both patients the aorta showed conical narrowing from the origin of the subclavian artery and the real constriction between the coarctation and the point of junction of the subclavian artery was much lower in the boy than in the farmer.

When re-examined about 6 months after operation both patients were in excellent health. The boy returned to school and the farmer worked at home. In the first case the systolic blood pressure in the left arm was 130 mm. Hg. and the diastolic pressure was 80. In the left leg the systolic pressure was 130 and the diastolic pressure 80 mm. Hg. In the second case the systolic blood pressure in the left arm was 145 and the diastolic pressure was 90 mm. Hg. In the left leg the systolic pressure was 120 and the diastolic pressure 80 mm. Hg.

It is remarkable that in both cases normal coarctation was established. The lives regarding the blood pressure in the legs was a little higher than in the arms and no hypertension was present. This postoperative effect is of considerable interest and is in favor of the mechanical theory of hypertension in coarctation.

II 33 1 F. TACKENBOM MD

Agar, J.L., Rawlands, J., and Odell, W.: Iliac Arterial Aneurysm following Injury to Iliac Vein.
Brit. M. J. 1915 2 455

The 2 cases reported by the authors are examples of arterial aneurysm following war wounds. In each case laceration of more than one iliac artery was necessary. The operations were accompanied by profuse and rapid hemorrhage to combat which profuse and rapid transfusion was necessary. Recovery was undoubtedly due to the promptness and completeness with which the blood loss was made good.

In each of these patients the surgeon was faced during the course of the operation, with hemorrhage at a rate with which transfusion could not possibly keep pace and the only way in which an immediate fatal issue could be avoided was by the application of a temporary packing and interruption of the operation until the circulatory volume had been restored to a reasonable level.

Detailed clinical histories and the findings in the 2 cases are presented—an aneurysm of the buttock in the first patient and a retroperitoneal aneurysm in the second patient. In the first case 14 pints of blood and 4 pints of plasma were given during the operation and a total of 27 pints was given during the first 4 days, from which there was no reaction.

In commenting the authors note that in the one case in which both internal iliac arteries were tied, the pelvic organs which should have suffered mani-

mum deprivation did not reveal evidences of damage. The heel, supplied by the external iliac artery which was not tied, showed arterial gangrene.

In the second case the nutrition of the limbs never seemed to be in danger even though not merely all the iliac arteries but the epigastric anastomosis which forms the most obvious collateral channel had been tied. The details of the operation for the repair of the retroperitoneal aneurysm are presented.

The authors note further that one of the most striking advances in surgery during the last 4 years is the progress that has been made in the use of whole blood. The advantages of an adequate blood bank for needed massive transfusions are pointed out and described. While blood transfusion undoubtedly has its dangers, these dangers are associated with the giving of blood to those who are gravely ill and who have been repeatedly transfused over a long period. Blood from a blood bank, properly prepared and given, seems to have no dangers in the type of massive post-traumatic hemorrhage in which it offers the only means of saving life.

HENRY F. THURLOW, M.D.

Zakerman, C. M.: Thrombophlebitis of the Cubital Veins in Blood Donors. *West J Surg* 1945 53 311

Among approximately 285,000 venepunctures performed at the Blood Donor Center, Chicago, Illinois, there was found to occur 12 cases of thrombophlebitis in the cubital veins following venesection. Of these 12 were in females and 1 in a male. The most important predisposing factors are listed as trauma to the vein wall and slowing of the blood flow by means of (a) the application of a circular bandage (b) hematoma, (c) systemic reaction (d) acute flexion of the forearm or straining of the arm during exercise following venepuncture.

Disability following thrombophlebitis of the cubital veins averaged approximately 4 months.

The best preventive measures are listed as follows:

1. Careful venepuncture technique.
2. The immediate discontinuance of the bleeding if a hematoma develops or if the donor complains that the needle causes discomfort.
3. Preventing the donor from flexing his forearm after venepuncture.
4. A circular bandage should not be applied as a dressing.

Eight of the donors mentioned had given blood for the first time and 4 were repeat donors. 7 of the donors developed hematoma. 5 donors were bled at the Fixed Center and 7 were cared for on the Mobile Units.

The author presents a table giving the essential data on the 12 donors who developed thrombophlebitis.

RICHARD J. BENNETT JR., M.D.

Silbert, S.: Thromboangitis Obliterans. *J Am M Ass* 1945 129 5

The criteria for the differential diagnosis between thromboangitis and arteriosclerosis in patients be-

tween 40 and 50 years of age are given as follows:

Thromboangitis obliterans

- Patient appears younger than his age
- Hair normally pigmented
- No arcus senilis
- Retinal arteries normal
- Blood pressure usually low
- Radial and temporal vessels soft
- Upper extremities frequently involved
- Femoral arteries frequently closed
- No calcification of vessels on x-ray examination
- Blood volume usually diminished
- Symptoms of coronary artery sclerosis rare
- Aorta appears normal on x-ray examination
- Albuminuria rare
- History of migrating phlebitis frequent

Arteriosclerosis

- Patient appears older than his age
- Hair usually gray
- Arcus senilis frequently present
- Retinal arteries usually sclerotic
- Blood pressure often high
- Radial and temporal vessels thickened and hard
- Upper extremities seldom involved
- Femoral arteries seldom closed
- Calcification of vessels on x-ray examination frequently seen
- Blood volume usually normal
- Symptoms of coronary artery sclerosis frequent
- Aorta sometimes appears elongated on x-ray examination

Albuminuria not uncommon

History of migrating phlebitis rare

One hundred patients with thromboangitis obliterans have been followed up for more than 10 years. All of them stopped smoking at the beginning of treatment and have not resumed since.

In all of the patients the disease has remained completely arrested following the initial period of treatment.

Thromboangitis obliterans is caused by smoking in individuals constitutionally sensitive to tobacco.

JOHN J. MALONEY, M.D.

Chapman, E. M., and Linton, R. R.: Mode of Production of Pulmonary Emboli. *J Am M Ass* 1945 129 196.

The authors believe that acts of straining such as holding the breath in inspiration and making an expiratory effort with the glottis closed, especially by those confined to bed from illness or operation, commonly result in sudden and often fatal pulmonary emboli.

The dramatic plugging of the pulmonary arteries by clots released from the leg veins after straining on a bedpan has been witnessed probably more often by nurses than by doctors.

There is a rise of several centimeters in the arm vein pressure during the forced expiratory effort with the glottis closed. The difference between this reading and the reading in the leg when the patient is recumbent is probably due to the fact that the

venous reservoir drained by the superior vena cava is much smaller and more subject to pressure by muscles and other structures. However when the patient is sitting in the bedpan position there is a great rise in the normal venous pressure in the legs (hydrostatic effect) and this in turn shows a greater increase on forced expiratory effort.

The release of mural thrombi that so often lie in the leg veins is due to the fact that the venous pressure and volume in the leg rise sharply during forced expiratory effort with the glottis closed. A clot located with this rise in the venous pressure there is a temporary impeding of the return of the blood to the heart, so that the peripheral veins become distended with blood, and this may loosen an imbricately attached mural thrombus. With the drop in venous pressure during the next inspiration the dammed venous blood rapidly empties from the peripheral veins which hang with it any loosely attached thrombus.

STEWART A. ZIEGLER, M.D.

Hampton, A. O., Prandoni, A. G., and King, J. T.: Pulmonary Embolism from Obsolete Sources. *Bull. J. A. S. Hosp. et H. p.* 1915 75 235

Ten cases are reported in which acute chest conditions appeared to have been caused by pulmonary embolism, with or without infarction. The emboli originated from various venous sources in ambulatory active individuals. Careful examination failed to show any signs of heart disease or of vascular disorders prior to the first embolic episode, with one exception. In 3 patients the source of embolism never became clear. No specific common factor was noted that could reasonably be supposed to have caused phlebotrombosis and embolism was elicited. There were 8 army officers in the group, which suggests that exertion may be a factor. At the time of admission there was no obvious sign of venous thrombosis except in one patient who had a thrombosed hemorrhoid. Accurate diagnosis in such cases is exceedingly difficult at the onset and none of the patients was admitted with a correct diagnosis. One was thought to have primary atypical pneumonia, 1 pericarditis with effusion, 1 ruptured peptic ulcer, 1 metastatic carcinoma of the lung, 1 angina pectoris, and 3 were thought to have coronary occlusion.

Röntgenograms of the chest are not very helpful at the onset since the shadow of infarction does not develop until a day or two have elapsed. In general dyspnea was more prominent than pain. A dull pain in the base of the neck or in a shoulder followed by pain in the axilla, should suggest pulmonary embolism. Elevation of the temperature within twenty-four hours of the first symptom is more suggestive of embolism than of coronary occlusion. Blood spitting occurs in less than half of the cases and then only after infarction has occurred. The most difficult differentiation is between embolism from a silent peripheral source and embolism from myocardial infarction. Serial electrocardiograms and phlebograms usually elucidate the diagnosis. The authors

found phlebograms very helpful in the diagnosis and had no serious results from the procedure. Criteria for the interpretation of phlebograms, roentgenograms, and electrocardiograms are recorded.

The treatment consisted of heparin and dicumaril anticoagulant therapy plus rest and elevation of the part affected by thrombosis or phlebitis.

JOHN L. LIVINGSTON, M.D.

Golodner, H., Morse, L. J., and Anglist, A.: Pulmonary Embolism in Fractures of the Hip. *Surgery* 1915, 18 418.

A patient who suffers a fracture of his hip presents ideal conditions for the development of venous thrombi in the lower extremities. The blood stream is slowed by the complete voluntary immobilization of the extremities to avoid painful movements at the fracture site by the associated reflex vasospasm induced by the fracture and by the impaired cardiac circulation and the inadequate peripheral circulation.

In the aged group. Concomitantly changes in the chemical composition of the blood conduce to thrombus formation as a result from the liberation of toxic ferment by the lacerated muscles, ligaments, and nerves at the fracture sites. Initial damage occurring when the patient is bedridden is enhanced when splints or Wilkie boots are utilized because of the greater pressure exerted against the calf veins by these plates of Dan encasement.

The most dangerous type is the "phlebotrombosis" or silent propagating thrombus because it lacks local symptoms and therefore a precaution is overlooked. The insidious silent propagating venous thrombus was predominant in Golodner's series. Not one patient gave any symptoms reflecting the presence of venous thrombosis in the lower extremity. As a rule some effort motion discharged the fatal pulmonary embolus in 1 case it was manipulative reduction in the operating room. In another transfer of the patient from a bed to a wheel chair in others turning the patient from one side to the other in bed. Deaths occurred as early as the sixth day and as late as the seventieth day following injury.

The occurrence of venous thrombosis and embolism is less frequent in patients who are made ambulant early and prophylactic bilateral superficial femoral vein ligation combined with lumbar sympathetic block is suggested as being most ideal for the prevention of pulmonary embolism in fractures of the hip especially in those who cannot be made ambulant early. STEWART A. ZIEGLER, M.D.

Gaston, E. A., and Felson, H.: Ligation of the Inferior Vena Cava for the Prevention of Pulmonary Embolism. *J. F. Med. J.* 1915 33 229.

The literature on vein ligation for the prevention of pulmonary embolism is reviewed. Femoral vein and common iliac vein ligations are discarded. Ligation of the inferior vena cava seems desirable, first to interrupt the venous channel above the en-

dent femoriliac thrombosis and second to prevent embolism from a simultaneous subclinal phlebotomy that is frequently present in the veins of the opposite lower leg.

Although it seems evident in a great majority of cases that pulmonary embolism arises from venous thrombosis originating in the vein of the lower legs and later progressing upward to involve the pelvic veins there are some cases in which the thrombotic process arises in the pelvic veins themselves.

Numerous reports of experimental rapid occlusion of the inferior vena cava by ligation have been published, beginning with the work of Lower in 1669. It has been repeatedly and conclusively shown that ligation above the level of the renal veins results in death, usually with accompanying anuria and uremia. Below the level of the renal veins experimental ligation of the inferior vena cava is compatible with life carries a low mortality rate and is associated with only slight and transient edema of the lower extremities.

The authors have reviewed clinical reports of inferior vena cava ligation in man and state that ligation of the inferior vena cava below the level of the renal veins although an operation of considerable magnitude is compatible with survival in both experimental animals and man.

Two cases are presented to illustrate situations in which an operation was followed by recovery. At the time of caval ligation both patients had suffered multiple pulmonary infarcts. Both had had previous common femoral vein ligation, bilateral in the first case and on one side only in the second case. Caval vein ligation was performed under spinal anesthesia supplemented by sodium pentothal in one case through a right rectus incision. The inferior vena cava was ligated in continuity with two nonabsorbable sutures 1 cm. apart at the level of the bifurcation of the aorta.

Mottled cyanosis of both legs was noted immediately after operation followed by pitting edema which came on in 4 hours. However there was gradual subsidence of this and 4 months after operation there was no edema in the first case and only minimal edema of the left leg in the second case.

The following points are considered most helpful in sustaining the patient through the critical post-operative period: swathing the feet, legs and thighs tightly in elastic bandages to help prevent shock due to the rapid withdrawal of edema fluid from the circulation; the early use of oxygen and adequate intravenous infusions of plasma and whole blood.

LUCIAN F. FROWDOTI M.D.

BLOOD TRANSFUSION

Britton C. J. C. and Warner C. P.: Leucemoid Blood Reaction Simulating Acute Aleuemic Leucemia in a Case of Phlegmonous Gastritis. *Lancet* Lond. 1945 249 430.

A case is reported wherein apparently the blood picture reaction to a phlegmonous gastritis so closely

resembled that of an acute aleuemic myeloblastic leucemia that the correct diagnosis was not made during life. The patient was a single woman aged 47 who developed a sore throat cold and temperature. After five days of treatment with a sulfonamide (identity and dosage unknown) she vomited. This illness was followed by weakness and an apyrexial symptomless period of about 10 days then the patient developed a high temperature headache and a slight cough, drowsiness, slow cerebration and pale mucous membranes and heavily coated tongue. The liver was palpable $1\frac{3}{4}$ inches below the costal margin and soft glands could be felt in the posterior triangle of the neck and in the groin. At this time the blood picture exhibited a total white count of 3,700 with a paucity of polymorphs (5.5%) and a large number of myeloblasts or promonocytes (45.0%). The lymphocytes amounted to 35.5 per cent there was only one normoblast but numerous platelets were found. Ten days later the blood picture showed a white count of 2,600 4 per cent of polymorphs 17 per cent of myeloblasts and 77 per cent of lymphocytes and 8 days later the picture was that of a leucopenia with 1,400 white cells with 8 per cent of polymorphs, 50 per cent of myeloblasts and 40 per cent of lymphocytes.

The patient did not at any time show material improvement in her condition under the picture of an anemia, hyperpyrexia, weakness and mental confusion she died a month after the onset of the illness.

Autopsy showed no evidence of leucemia in any organ. In the bone marrow there was a moderate increase in the erythroblastic and myeloid tissue but no myeloblastic reaction was noted. The most striking finding was an acute phlegmonous gastritis with ulceration and gangrene low grade peritonitis and bronchopneumonia were also present.

Since the clinical findings all pointed to a diagnosis of acute aleuemic leucemia and the patient was obviously dying when she came under the authors' attention, confirmation of the diagnosis by means of a splenic puncture was not considered necessary and therefore the autopsy findings were a complete surprise.

JOHN W. BRENNAN M.D.

Thierach J. B.: Attempted Transmission of Human Leucemia in Man. *J. Lab. Clin. M.* 1945 30 866.

Whereas in fowls and mice leucemia can readily be transmitted in susceptible strains and only a minimal amount (one leucemic cell) of leucemic material is necessary for a successful transmission all attempts of previous workers and the ones described herewith to transmit this condition in man have failed. So far no transmission of leucemia from man to man, by means of blood, lymph node or spleen, has been established. The reason for this failure might be sought in the following factors.

The technique employed. The assumed leucemic agent might not be able to contact sufficient susceptible cells of its own type that is cells of the bone

marrow or lymph nodules, by the subcutaneous or intravenous routes, which were employed for the attempted transmission. The agent of human leucemia might be extremely sensitive and not survive the procedure of transmission.

The material used. Whole blood lymph nodules and spleen might not be suitable for transmission in that they might either contain no leucemic agent or have it only in an inactive form.

The time of observation. The time of observation in many cases was certainly very short but even 2 months might not be sufficient time for the agent to establish itself and produce a leucemia.

The choice of hosts. Only people with a life prospect of under two years were available and all suffered from incurable diseases, the recipients could not be regarded as "virginal organisms." These patients might have had sufficient antileucemic factors to prevent a take.

The recipient might also have had a natural immunity might have belonged to a non-susceptible strain of man, or might have had an acquired immunity which protected him against any leucemic agent.

It also might be that human leucemia, contrary to animal leucemia, cannot be transmitted and therefore all attempts at transmission were useless from the start.

The fact that even material from acute leucemias would not produce reactions in the recipients is remarkable as one would expect that this type of leucemia with its fulminant course would be the easiest to transmit.

Of all the factors mentioned, the difficulty of obtaining suitable hosts and the apparently unexplained route were the most important and might certainly have been responsible for the negative results of the transmission attempts. *By JAMES COLLIER, M.D.*

SURGICAL TECHNIQUE

OPERATIVE SURGERY AND TECHNIQUE POSTOPERATIVE TREATMENT

Fomon, S. L. Nongro, R. Schattner, A., and Turchik, F.: Cancellous Bone Transplants for the Correction of Saddle Nose. *Ann Otol Rhinol* 1945 59: 518.

An ideal nasal transplant should be readily available in sufficient quantity and have a consistency that will permit easy modeling. It must resist infection and absorption, be well tolerated by the tissues, and not subject to change in shape after implantation. While a graft meeting all of these specifications is still being sought the authors believe that at present cancellous bone obtained from the ilium is the material of choice. Next to cancellous bone, cartilage is probably the most satisfactory material for nasal grafts but it has certain undesirable qualities not encountered in grafts of cancellous bone. It is prone to curl and its failure to form an organic union with the nasal bones, to which it becomes united only by means of fibrous tissue frequently leads to an unnatural mobility.

In preparing for the operation a cast is made of the nasal defect and from this a stent is built up to the normal contour. This model is sterilized at the time of operation to aid in the shaping of the transplant. The first step in the operation is the preparation of the bed which is to receive the transplant. A circumferential incision is made in the left vestibule along the lower lateral cartilage and through this the soft tissues are separated from the dorsum of the nose. At the upper end the periosteum is undisturbed for the reception and immobilization of the tapered end of the proposed transplant. If a columellar strut is needed an incision is made along one side of the membranous septum and through this a bed is made in the columella between the two mesial crura.

The surgeon and assistants then change gown and gloves and freshly sterilized instruments are supplied to prevent cross-contamination as the transplant is obtained. The iliac crest is exposed through a curved incision and the periosteum and a thin layer of cortical bone are then resected from the bone of appropriate size is then removed. To prevent splintering the graft is undercut with a thin broad chisel first on one side and then on the other in an oblique manner so that the cuts will meet beneath the center of the graft at the required depth. No attempt should be made to elevate the graft until it lies free in its bed. A motor driven saw is not recommended in this procedure because it is believed that the heat which it engenders tends to impair the viability of the bone.

The graft is then shaped in accordance with the pattern made from the cast. The upper end is taper-

ed to a thickness of from 1 to 3 mm. so that it will fit easily into the perioskeletal socket at the nasal root. The lower end is tapered to blend with the tip. It is then inserted into the prepared bed. Any blanching of the skin over the graft indicates too great tension upon the surrounding soft parts and under such circumstances either the graft must be removed and made smaller or the soft tissues must be undercut sufficiently to assure tensionless reception of the transplant. The incision is closed with atraumatic sutures and the nose loosely packed with vaseline gauze. The graft is held in position externally by narrow strips of adhesive tape applied around the tip and over the bony dorsum. To protect the nose against trauma and minimize postoperative edema a stent dressing is firmly applied and held in place with adhesive strips.

The authors have used cancellous bone for nasal grafts during the past three years and have found it far superior to other material used for this purpose.

JOSEPH J. McDONALD, M.D.

Barley O. T. Ingraham, F. D., Swenson O. Lowrey J. J. and Bering, E. A.: Human Fibrin Foam with Thrombin as a Hemostatic Agent in General Surgery. *Surgery* 1945 18: 347.

This article records the findings and results of carefully planned experimental and clinical investigations, and the conclusions reached are based upon controlled pathological and clinical observations in a sufficient material.

In 5 monkeys, lacerated wounds of the liver were packed with fibrin foam with thrombin; the wounds were sutured and examined at intervals of 30 minutes 4 hours and 21, 70 and 74 days.

In 4 monkeys a 1 cm. cube of fibrin foam soaked in human thrombin solution was inserted deep in a stab wound of the liver. The wounds were sutured and examined after an interval of 11 and 16 days, and 8½ and 12 weeks. This procedure was repeated in conjunction with the hemostatic materials and the specimens were examined 8 days and 5½, 8, 9 and 12 weeks later. In another monkey this procedure was repeated except that a cube of fibrin foam with thrombin that had been dipped in penicillin was placed in a second stab wound. This animal was sacrificed 34 days after the operation.

In 5 monkeys a cube of fibrin foam with thrombin was placed between the traumatized liver and the diaphragm and the animals were given an autopsy examination at 3 (2 animals) 4½, 8 and 12 weeks. This procedure was repeated with the variation that the fibrin foam, after soaking in thrombin was rolled in sulfadiazine powder and the autopsies were done at 5½, 8 (2 animals), 8½ and 12 weeks.

In 3 monkeys, which were sacrificed 3, 7 and 13 days respectively after operation two stab wounds

cubic centimeter or higher. With intramuscular dosage, the 2 hour penicillin level is almost always below the *in vitro* sensitivity of the organism. Thus therapy may be ineffectual for a significant portion of the time between injections. Besides, many patients do not tolerate fractional intramuscular injections. The necessity for frequently repeated injections will also interfere with the rest of the patient.

The authors believe, therefore, that the fractional intramuscular method of penicillin administration can be recommended in the treatment of disease due to bacteria which are highly susceptible to the action of penicillin, and when the span of the treatment is relatively short as it is in gonorrhea and pneumonia.

The method of continuous intramuscular infusion is technically simple. Its maintenance causes serious complaint from the patient. The thigh muscles of the average patient were found to tolerate only 750 c.c. of solution per day. More than this resulted in acute muscular soreness and necessitated discontinuance of the infusion. Besides, in the same penicillin concentrations following the continuous intramuscular drip tended to be consistently lower than those obtained by the continuous intravenous drip.

The method of continuous intravenous drip is technically more difficult than fractional or continuous intramuscular dosage. The use of 23-gauge needles and the utilization of veins about the wrist or arm, and legs overcome many of the difficulties. This method causes minimum discomfort and is well tolerated.

The incorporation of heparin in the venoclysis is believed of value in continuous intravenous therapy. It is possible to keep the drip at a single site every 3 or 4 days. The high serum levels thus obtained make it possible to attack infections hitherto considered inaccessible to penicillin therapy. Extreme resistance of an infecting agent should no longer be a deterrent to attempts at penicillin treatment. Massive dosage even up to 10,000,000 units per day does not produce symptoms of toxicity.

SAMUEL KAREN, M.D.

ANTISEPTIC SURGERY TREATMENT OF WOUNDS AND INFECTIONS

Harvey E. N., Butler E. G., McMillen J. H. and Puckett, W. O.: Mechanism of Wounding
Il or Med., Chic., 1945 8 9

High velocity missiles have been observed by means of high speed moving pictures (from 2,000 to 7,000 frames a second) showing the movement of the missile in water and gelatin gel. Roentgenograms taken with a one millionth second exposure demonstrate that similar changes occur in living tissues of anesthetized dogs and cats. This investigation exhibits shock waves in tissues, the formation of a

very large temporary cavity which pulsates several times before subsiding, a region of extravasated blood and a permanent cavity larger than the cross sectional area of a missile.

In general, it can be stated that the effect of penetration of a high velocity missile is analogous to that of a little explosion within the tissue.

The article is accompanied by 17 figures showing the successive steps of the penetration of a missile and microsecond roentgenograms of missiles passing through tissues and substances.

RICHARD J. BENNETT, JR., M.D.

Young, M. W.: Mechanics of Blast Injuries
Il or Med. Chic. 1945 8 73

During the present war some antipersonnel mines and concussion bombs were preceded by pilot bombs, screeches, noise makers, buzzes, or even sirens and these were apparently designed to produce a reflex contraction of the voluntary muscles of the body and thus, in turn, produced an initial increase in venous and cerebrospinal fluid pressure. Voluntary muscle contraction will produce an increase in venous pressure. An increase in venous pressure is transmitted to the cerebrospinal fluid. When an actual bomb explosion follows the preliminary noise, persons nearby to voluntarily contract all their muscles thus raising the venous pressure when the actual explosion occurs this increased venous pressure is again greatly increased by the sudden explosion which causes a wave of increased atmospheric pressure. This concussion wave causes a sudden increase of atmospheric pressure surrounding the body and it produces an increased pressure on the body and its fluids. Sailors undergo a similar experience when caught by the water concussion wave of a depth charge. When applied to the body this increased pressure may be as much as several atmospheres. The pressure on all the body surfaces and fluids is increased except within the craniovertebral space which is protected from external forces by a firm bony globe. The pressure within the cranium at the instant of increased atmospheric pressure is for other areas is literally squeezed into this low pressure area in the cranium. The cranium becomes quickly filled with fluid and then experiences the maximum force of the external pressure.

Experiments were carried out in which preliminary ligations of the jugular veins were done, and the sudden external pressure was applied. It was demonstrated that preliminary ligation of the jugular veins will almost completely prevent the increase in intracranial pressure. From the practical standpoint when preliminary noises give warning of an impending explosion, it would be to the individual's advantage to be taught to compress his jugular vein rather than cover his ears by so doing he is able to protect his nervous system from the greater compression soon to follow.

RICHARD J. BENNETT, JR., M.D.

Radgett, E. C., and Gaskins, J. H.: The Use of Skin Flaps in the Repair of Scarred or Ulcerative Defect over Bone and Tendon. *Surgery* 1941 9 137

The results and conclusions cited in this article are based upon a series of 9 patients operated upon during a 15 year period for the purpose of correcting chronic ulcerative lesions or deep adherent scars. The majority of lesions were on the extremities.

In selecting the optimum method for coverage of such defects one has to balance the utility of a skin graft against that of a skin flap. Each has certain advantages. A skin graft can usually be placed in one operation, while a skin flap will take at least two operative procedures. A skin graft has about normal thickness and gets its nerve supply quicker than a skin flap, which is often rather thick in appearance. In general, a skin flap has the advantages of a fairly high resistance to infection, some thickness for the purpose of filling a defect, it slightly lengthens an amputated extremity, and it covers a thumb or finger reconstructed by means of a bone graft with subcutaneous tissue. It can be used to cover exposed tendon, nerves, and bones and it retains tissues with sufficient blood supply such a radiation necrosis and sloughs. For the building of a scarless region of thickness for building a part requiring a soft pliable epithelial surfaces and some thickness such as the nose, the cheek, and the lip, and a direct coverage of bone or cartilage the pedicled skin flap has little competition.

It is emphasized that often a skin flap can be transplanted to the opposite leg, ankle, or foot with safety and the resultant aseptic denuded base from which the flap was removed covered by a skin graft at the first operation, which saves time and a considerable number of operations.

In 5 of the 9 cases treated by the authors flaps were used to cover bull-dog feet. Before rotation flaps of the scalp were transferred successfully in one stage. In 27 cases flaps were transferred to the fingers, hand, or arm; the majority were male from the abdomen and were transplanted in two stages. Of these 3 did not hold; 2 failures occurred in small children from whom it was difficult to obtain the needed cooperation. Body flaps were used in 3 cases to cover a ray burn, one of the scrum, one of the groin, lower abdominal and upper thigh, and one over the lower abdominal. Partial sloughing of the flaps occurred in 1 of these cases.

In the cases in which the flaps were applied to the lower extremity the majority of the lesions were due to trauma. In 15 cases the flaps were used. One of these a very useful pedicled flap did not take because of necrosis of the distal end. In 45 of 49 cases leg flaps were used. In only 3 of these was the "take" delayed—a flap was cut off but a second was partially lost. In the latter case the flap was reapplied and a successful result obtained. In 5 other cases there was a partial but not a complete loss.

In a case with a large defect over the ankle and a bulbous foot, pedicled lateral flap was raised after

a relaxing incision was made posteriorly, the skin and subcutaneous tissue brought forward and sutured to the skin and subcutaneous tissue. In only 1 of the 49 cases was the result entirely satisfactory. One wound became infected and a bad partial loss of the flap which required transfer of a flap from the opposite calf.

JOHN J. McDEVITT, M.D.

Patterson, T. C., Keating, C., and Clegg, H. W.: Experiences in the Prophylaxis and Treatment of Clostridial Infection in Casualties from the Invasion of Europe. *Brit J Surg* 1941 33 1

The authors report 16 proved cases of clostridial infection which were treated by local excision of the gangrenous muscle as full a cure as circumstances permit or if no alternative remained, by amputation. The wounds were irrigated freely with a 1% hydrogen peroxide solution to remove the bacteria and lightly dried after which they were covered with a "frost" of sulfathiazole and a percentage of rosin. This irrigation and frosting was repeated twice frequently produced a wound which healed rapidly, often an early secondary suture was possible.

Sulfathiazole was the drug of choice. In the majority of cases a dose of 2 gm. was given, 1 gm. every 4 hours.

Anti gas gangrene serum was also used in 10 cases. The normal procedure was to give 15 to 30 c.c. diluted with equal parts of saline solution, intravenously and to supplement this with 10 c.c. intramuscularly. The dosage was repeated every 6 hours until it was considered that the toxin had been eliminated and the wounds were well on the way to being healed. Each cubic centimeter of the solution contained 4,500 units. The largest dose was 450 c.c.

Penicillin was used prophylactically in 1 case. It was concluded that penicillin could not be depended upon to prevent the development of anaerobic infection. It was used intramuscularly at an initial treatment in 9 cases—15,000 units b.i.d. every 3 hours.

There was 1 death from bronchopneumonia and the anaerobic infection had not been treated. Amputations were performed of 3 arms and 3 legs.

In summary the authors conclude that a real victory is still the keynote of prophylaxis and treatment of gas gangrene. The most useful antibiotic at present are anti gas gangrene serum in combination with sulfathiazole. The place of penicillin in the prophylaxis and treatment of gas gangrene is proved and must remain uncertain until further investigation has been carried out.

LEON J. McDEVITT, M.D.

Cleghill, W. C.: Gas Gangrene Thigh Thwart Cases, with 1 Death. Treated at a Forward General Hospital in Italy. *Lancet*, Lond. 1941 1 1

Clostridial infection was a serious problem in the forward hospitals. The little scene moved from the

the European theater. Heretofore most reports have dealt with cases seen chiefly at the forward casualty clearing stations and the field surgical units level and have shown fatality rates of from 30 to 60 per cent.

The 33 cases reported here were treated at a forward general hospital in Italy and there was but 1 death, which occurred long after the clostridial infection had been controlled. Most of the infections were recognized in from 4 to 5 days after wounding and may have been less fulminating and severe than the previously reported cases, however at least 10 of the cases were fulminating so that some other explanation of the low mortality must be sought. Although ample supplies of penicillin were available, it was not considered justifiable to depend on this drug alone. Full use was made of blood gas gangrene antiserum and sulfonamides.

The diagnosis of gas gangrene is essentially clinical. In general the most reliable signs of clostridial infection were pain or heaviness in a limb, a rising pulse rate with moderate pyrexia, curious mental alertness, icteric tinge of the facies with circumoral pallor, low blood pressure, the characteristic odor and the lifeless appearance of the muscles. Crepitus was not a prominent sign. Its presence is not a reliable guide to the extent of infection in the underlying muscles, for it is ordinarily found in the subcutaneous tissues well in advance of the muscle involvement. The importance of this fact is illustrated by 2 cases in which crepitus could be elicited up to the abdominal wall, and yet it was possible to amputate successfully through the middle or upper thigh.

Cases were classified as of 3 definite clinical types: gas abscess (6 cases), clostridial myositis (17 cases) and fulminating gas gangrene (10 cases).

The sheet anchor of treatment in fulminating gas gangrene is early surgical removal of the source of the toxemia. This usually means amputation in cases in which it is possible, or muscle excision on a large scale. The principle of efficient surgical excision must still be maintained, but experience with penicillin and the sulfonamides encourages the hope that a more conservative approach may be justified in the future. As experience with and confidence in penicillin increased in this series, the approach became less radical, with the result that several limbs were saved. In addition to large amounts of blood and antiserum, the average parenteral dose of penicillin per case was from 300,000 to 500,000 units given at 3 hourly intramuscular injections of 100,000 units. As the outcome is usually determined in from 24 to 72 hours, this will suffice. Most patients were given a course of from 25 to 30 gm. of sulfathiazole.

A very low mortality rate was achieved and the number of amputations (5) was low. Although as a group the cases were of less severity than those seen in forward areas, all the men were extremely ill on admission and the 10 fulminating cases were comparable to those seen in the field surgical units. Penicillin used prophylactically both locally and

parenterally did not prevent the onset of gas gangrene.

JOHN L. LINDQUIST, M.D.

Meleney, F. L., Friedman, S. T. and Harvey, H. D.
The Treatment of Progressive Bacterial Synergistic Gangrene with Penicillin. *Surgery* 1945
18: 423

Progressive bacterial synergistic gangrene, due to the associated presence of a microaerophilic non-hemolytic streptococcus and a hemolytic staphylococcus aureus is now accepted as a clinical entity. The authors report 3 cases of this malady that were treated with penicillin.

A patient critically ill with pulmonary abscesses and empyema, failed to respond to sulfadiazine and was treated by resection of a rib and drainage. The typical lesion of progressive bacterial synergistic gangrene developed around the wound in the chest wall. The use of penicillin intramuscularly and intrapleurally resulted in healing of the gangrenous ulcer and cure of the patient.

In a second patient an enterostomy was done following resection of the gangrenous terminal loops of the ileum. Although sulfadiazine was used post-operatively, the patient developed the lesion of progressive bacterial synergistic gangrene around the enterostomy wound. The spreading infection was brought under control by the use of penicillin intravenously and the lesion healed.

In a third case of multiple boils a number of bacterial species including the microaerophilic non-hemolytic streptococcus and the staphylococcus aureus were isolated. In this patient the lesions while they had most of the characteristics of the progressive bacterial synergistic gangrene as described in previous reports, differed in three respects. In the first place they were multiple, second they were not excruciatingly painful, and third the zone of gangrene was relatively narrow. These lesions responded unsatisfactorily to penicillin or to other forms of therapy and the patient died from a pulmonary embolus.

The sulfonamides have not been effective in controlling progressive bacterial synergistic gangrene, but penicillin offers real hope.

DAVID H. LYNN, M.D.

Brown, C. W., McClintock, L. A. and Neary, E. R.:
Established Surgical Infections. Treatment with Urea-Sulfanilamide Mixture. *Am J Surg*
1945 70: 4.

The topical use of sulfonamides alone in necrotic or purulent wounds is known to be of little or no therapeutic value. On the other hand, reports of experimental and clinical studies indicate that in the local treatment of grossly infected wounds urea-sulfonamide mixtures possess valuable antibacterial and related therapeutic properties.

The purpose of this investigation is to evaluate the urea-sulfanilamide mixture in the local treatment of established chronic surgical infections. The urea-sulfanilamide which was used was a crystalline mix-

ture consisting of 3 parts of urea and 1 part of sulfanilamide. This specific mixture was selected as most satisfactory on the basis of experimental and clinical observations. The crystalline components in the selected mixture when generously applied to a wound supplied the maximal percentage of relatively insoluble sulfanilamide which would not give rise to foreign-body reaction, and an excess of freely soluble urea sufficient to assure its prolonged action *in situ*.

It was supplied in sealed, resilient, plastic tubes within which the crystalline drugs had been sterilized by a nontoxic, chemical process that does not adversely affect either the urea or sulfonamide crystals. Sixty hospitalized cases of serious—chiefly chronic—surgical infections were studied. They represented most of the usual variety of such infections seen in general hospital practice and consisted of hematogenous and post-traumatic osteomyelitis, purulent and necrotic skin defects that required grafting, pulmonary abscess and thoracic empyema with external sinus tracts, and miscellaneous cases including infected postoperative wounds, trophic ulcers.

In addition, several cases of suppurative peritonitis were studied particularly to determine the rate of absorption of sulfonamide from an infected serosal surface following the topical application of urea-sulfanilamide. In all cases in which the infected wound was external the lesion was dressed once daily and the entire surface area of the wound was freely covered with insufflated urea-sulfanilamide. This required the daily application of from 10 to 20 gm. of the mixture per patient. In cases of draining lung abscess and empyema, from 10 to 30 gm. of urea-sulfanilamide per day were applied locally after insertion of the insufflating container into the fistulous tract. The more devious fistulous tracts were filled daily with the mixture by means of a soft rubber catheter attached to the insufflating container. Intraperitoneally a single dose of from 10 to 20 gm. of urea-sulfanilamide was implanted at the time of operation.

Careful appraisal of a chemotherapeutic agent in surgical infections requires a plan of investigation that considers the many variable factors which may influence the results including among other determining elements the duration, previous treatment, extent of tissue destruction, and bacterial population of each infection.

Frequent studies of the qualitative and quantitative bacterial population of all wounds provided a means of confirming clinical response to treatment with urea-sulfanilamide. Wound cultures were made at the start of treatment and, insofar as possible every three to five days during treatment with the mixture. Specially prepared media which absorbed approximately 0.1 cc. of fluid, were used to obtain samples of wound exudates. From saline suspensions of these aerobic and anaerobic cultures and colony counts were made on meat infusion agar, respect- ively, and on selenite F-thioglycollate agar, respectively.

Cultures on blood agar and in tryptic soy broth were also routine. In addition, serial dilutions of the antibacterial threshold concentration of sulfanilamide for organisms isolated from wounds at the start of treatment helped to evaluate the degree of sulfanilamide-resistance that these bacterial invaders manifested in failing to require an earlier treatment with sulfonamide alone.

Periodic hemopoietic, blood chemistry and pertinent laboratory studies were made in all cases. Clinical progress was charted and recorded in the usual way.

As urea-sulfanilamide comes in contact with a purulent exudate it rapidly goes into solution. As long as the wound discharge is profuse a dry dressing is best used after infiltration of the mixture into the wound. Local edema rapidly subsides as the amount of wound exudate greatly decreases within a few days. At this point it has been advisable to employ dressings soaked in saline solution instead of dry gauze dressings. Saline dressings prevent dryness and crusting of the productive wound and do not impede local absorption of the mixture.

As wound edema subsides it seems that a vascularization occurs and granulation progresses more rapidly than usual. When healthy granulation has appeared and wound discharge is scant, much smaller amounts of insufflated urea-sulfanilamide suffice and do not retard epithelialization as large quantities of the mixture are likely to do at the stage of treatment. In the pregrafting preparation of infected skin defects, however, generous quantities of urea-sulfanilamide may be topically applied up to the time of grafting.

In none of the cases studied has any reaction occurred that could be construed as a reaction of local or systemic toxicity to urea-sulfanilamide. No significantly abnormal findings attributable to the use of the mixture have been demonstrated in frequent hematological and urinary studies throughout treatment.

BERNARD GREEN, M.D.

Ory, E. M., Meads, M., and Finland, M.: Penicillin V. *J. Am. Med. Ass.* 1945 129 157.

Several forms of penicillin have been described as cultures of penicillium notatum. Three of the known penicillins F, G, and V in this country are penicillin 1, 2, and 3 respectively. In Great Britain have been isolated in crystalline form. Commercial penicillins prepared from deep vat cultures contain almost entirely of penicillin G, but those prepared from shallow surface cultures in flasks may contain appreciable amounts of penicillin V ranging from 20 or 25 per cent.

When tested simultaneously with penicillin containing 65 per cent or more of penicillin V and with commercial G is which exhibit almost equal activity. Penicillin G is more active against streptococci, pneumococci and meningococci than penicillin V. It is times more active in penicillin V against strains of pneumococci and meningococci.

viridans were twice as sensitive to penicillin λ and most of the staphylococci were equally sensitive to the two kinds of penicillin.

Levels of penicillin activity in the serum against a strain of hemolytic streptococcus were significantly higher and sustained longer after intramuscular injections of penicillin λ than after injections of the same number of units of regular penicillin.

The methods used both in determining the sensitivity of bacteria and in estimating the serum concentrations are admittedly crude. It is most unlikely however that the consistent differences between the commercial preparations and the lots of penicillin λ observed in the authors' studies could be explained on the basis of such methods. The results obtained with the different lots of penicillin serves to emphasize the superiority of the penicillin λ .

The findings suggest that comparable therapeutic results may be expected with the use of smaller doses or with the same doses given at longer intervals when penicillin λ is used.

A preliminary clinical trial indicated that penicillin λ is nontoxic and at least as effective as regular penicillin in the same doses in cases of pneumonia and probably more effective in gonococcal infections. Further clinical trials with the use of smaller doses and longer intervals are necessary in order to establish the therapeutic superiority of penicillin λ .

JOSEPH K. NARAT, M.D.

Ulrich, H. L., and Dowling, H. F.: Observations on the Continuous Intramuscular Method of Administering Penicillin. *Am. J. M. Sc.*, 1945 310 435.

Use of the constant intramuscular method of penicillin administration in 110 patients is reported and the concentration in the blood of patients studied is compared with that achieved by other methods.

The amount of sodium penicillin required for 12 hours was usually dissolved in 1,000 c.c. of isotonic salt solution and allowed to flow at a constant rate of from 30 to 40 drops per minute into the lateral aspect of the thigh or into the gluteal muscles. When administered at the rate of 200,000 units in 24 hours the concentration of penicillin in the blood remained constant and at therapeutically effective levels 96 per cent of the time whereas with the injection of 25,000 units every three hours similar concentration was obtained only 80 per cent of the time. The corresponding figures for the injection of 20,000 and 15,000 units every 2 hours were 67 and 63 per cent respectively.

No deleterious effects or complications were observed except for mild to moderate pain or discomfort at the site of injection in 6 patients. Pain was usually prevented by changing the location of the needle every 24 to 96 hours. Prompt and complete relief of pain was obtained by the addition of procaine to the penicillin solution. This method

avoids repeated painful intramuscular or intravenous injections, traumatization of the veins and phlebotrombosis. The patient has almost complete freedom of activity.

The authors believe the continuous intramuscular drip to be the method of choice in very ill patients who require continuously high blood concentrations of penicillin.

WALTER H. NADLER, M.D.

Bailey, H.: The Treatment of Cervical Collar-Stud Abscesses with Skin Involvement. *Brit. J. Surg.*, 1945 33 53.

The author describes his experience with 200 cases of tuberculous collar-stud abscesses. Conservative management of these cases consisting of aspiration incision or incision and scraping is considered a pernicious practice. Wide open excision is recommended.

In about 25 per cent of the cases the superficial abscess does not overlie the broken down glands that feed it; indeed the 'factory' and the 'storehouse' may be as much as 6 or 8 inches apart. If success is to attend the method of treatment it is fundamental to remove not only the abscess but also the degenerating glands and the isthmus which connects them.

A proper preoperative clinical examination of the whole neck will unmask the long stemmed collar stud abscess which is the one requiring special consideration.

The standard technique of treatment is as follows:

1. Excision of all unhealthy skin, including skin that at first sight appears healthy but on closer examination is found to be undermined and pathological on its under surface.

2. Complete dissection of relevant diseased lymphatic glands. When the sternomastoid interferes with their clear display the muscle is divided and subsequently reuniting.

3. Hemostasis being rendered as perfect as possible the cavity is sprinkled with sulfanilamide powder and the hole filled with vaseline gauze as it enters the wound, powder is poured on to the gauze, which is never allowed to touch the skin. The vaseline gauze must be of the right consistency; if it is too soft it tends to become displaced and if too dry it sticks to the granulations.

4. The cavity having been packed moderately firmly and filled completely but not to overflowing more sulfanilamide powder is sprinkled on to the surface and a piece of the tulle gras laid over the mouth of the wound so as to overlap its edges.

5. A viscopaste bandage is applied in such a way as to immobilize the neck. Formerly the author used a plaster cast. It is of great importance that the bandage be applied properly so that the patient, often a child, cannot displace it and expose any part of the wound.

The author stresses the fact that all diseased glands must be removed as otherwise a chronic sinus will develop. If during the intervals of repacking the bandage becomes disarranged and the wound becomes exposed secondary infection is likely to occur.

Dressings should be changed every 7 days under absolute aseptic precautions, this should be done by a competent person. In making incisions the surgeon must take Langer's lines into consideration.

In describing the end results the author states that large craters in the neck readily develop clean granulating surfaces and become epithelialized without skin grafting. More often than not the resulting scars are not unsightly and are often linear.

LLOYD J. FROBERT, M.D.

ANESTHESIA

Lundy J. S. Adam, R. C., and Seldon T. H.: Factors Influencing Trends in Anesthesia. *Surgery* 1915 8:1.

At the Mayo Clinic the use of methods of anesthesia in the application of which special personnel is employed (for example, spinal and regional anesthesia that is administered by the professional anesthetist, intravenous anesthesia, intratracheal anesthesia, cyclopropane curare and so forth) has increased from 6.7 per cent in 1912 to 65.4 per cent in 1913. Tribromethyl alcohol as a rectal anesthetic has been more satisfactory than oil and ether by rectum. Barbiturates by rectum plus tribromethyl alcohol still has an apparent advantage over tribromethyl alcohol alone. The use of acetylene was discontinued after 1910 because of the danger of explosion. Since 1917 intravenously administered pentothal sodium has been employed in about a third of the cases in which special methods of anesthesia were used.

The explosion hazard in the use of cyclopropane is well recognized and there have been reports of sudden collapse of patients at the end of long operation, as well as of fibrillation due to the drug. It would appear that if one observes the recommended precautions in the use of cyclopropane it is a wholly useful agent but it is not an essential one except in a limited field, particularly thoracic surgery.

The use of Magill's intratracheal tube has greatly enhanced the value of the inhalation anesthetic agents.

For the last eight years there has been little change in the percentage of employment of the agent used at present.

Barach, A. L., and Rosenstine, E. A.: The Hazard of Anoxia during Nitrous Oxide Anesthesia. *Anesthesiology* 1915 6:412.

The morbidity and mortality following the use of nitrous oxide for surgical anesthesia have increased despite the refinements of administration and the more modern techniques. The safest of all anesthetic agents "used in 1900 has become one of the most if not the most, dangerous one today. Its strongest endorsement has been its lack of toxic reaction and its use in cases of immobility and its lack of discomfort for the patient through its rapid, pleasant induction and emergence. Its single serious imperfection is its lack of potency. In order to fulfill

the requirements of surgical anesthesia in a patient who has not received previous depressant drug medication, the degree of anoxia must be accompanied. Previous reports from other clinics have demonstrated that patients anesthetized by nitrous oxide will always suffer from a severe degree of anoxia. When the percentage of oxygen in the inspired gases is below 13 per cent the arterial oxygen tensions were in the range of extreme hypoxia, 30 mm. of mercury.

The extensive studies of Courville and other research workers have shown that serious as well as fatal results may follow nitrous oxide anesthesia even though it is administered without gross error and by accepted techniques. Examples are given of patients who had died suddenly during anesthesia with nitrous oxide or who had died a few days after the agent was used. Another group of cases was discussed in which recovery occurred but residual mental symptoms indicated cerebral damage of the nervous system. A final group of patients who had transient mental and emotional manifestations but apparently recovered completely. There is essential agreement with Courville's view that such lesions most often include severe and scattered pyramidal nerve cells, patchy necrosis, degeneration of various cortical layers, subcortical degeneration of limited portions of the cortex, and lesions in the lenticular nucleus. It seems probable from Barach's work and others that permanent damage in the frontal lobe cortex as well as in other areas of the brain may take place with little change in personality change although subtle disturbances in emotional response may have been produced. Next to the brain the heart is the organ most sensitive to anoxia. This may be manifested by coronary insufficiency without the warning signs of pectoral pain.

The authors propose the dispensing of cylinders containing 40 per cent nitrous oxide and 60 per cent oxygen to avoid the possibility of anoxia during nitrous oxide administration. Each cylinder should be filled with 150 gallons of the mixture at 2000 pounds per square inch to permit a uniform emergency flow of 10 per cent gas mixture. The authors have argued against the so-called "gas oxygen" cylinders which deliberately expose the patient to severe anoxia, the result of which may be psychomotor paralysis, personalty defect or death from cerebral or respiratory failure. MASON K. M.D.

Mawson, G. M. C., and Deland, E.: Influence of the Liver and Kidney on the Duration of Anesthesia Produced by Barbiturates. *Anesthesiology* 1915 6:453.

The object of the authors was to study the effect of barbiturates by means of partially heparinized and completely rephrenotomized animals. It was whether or not a relationship existed between the duration of action of these compounds and the effect of their detoxification. The patients who were used in the experiment were brought up to date with the

ous references. The method of procedures was described in detail.

Twenty-nine barbituric compounds were studied and the results tabulated in such a manner as to suggest a new classification of the barbiturates according to the site of their detoxification. The index of detoxification was represented as the average duration of anesthesia of control animals is compared with average duration of anesthesia of experimental animals. This index figure was determined for each compound in the partially hepatectomized and the completely nephrectomized animals.

The authors suggested that group 1 contain those barbiturates detoxified mainly in the kidney—barbital and phenobarbital; group 2 contain those barbiturates detoxified mainly in the liver—lithol, amobarbital, oral, alurate, nortal, secobarbital, pentobarbital, and thioethamyl; group 3 contain those barbiturates detoxified approximately equally in the liver and kidney—neonal, delvalinal, phenodorm, and dial; and group 4 those barbiturates possibly detoxified in all the tissues of the body but not to any great extent in the liver or kidneys—pentothal, propyl 1-methylallyl and allyl 1-methylallyl thiobarbiturates.

MARY KARP, M.D.

Robin, P. A. and Collins, V. J. Roentgenological Study of the Male Sacrum As an Aid in Caudal Analgesia. *Anesthesiology* 1945 6 505

Fifty unselected cases were subjected to a preliminary roentgenological examination of the sacrum. Caudal analgesia was then carried out independently and analysis of the results made. The method of x-ray study was described in detail.

A routine anteroposterior view of the sacrum was obtained to determine the apex of the caudal canal and to measure the transverse diameter of the caudal canal hiatus at the level of the 4th sacral segment. Body section roentgenography was used for the lateral view and three or four planigraphic views were made close to the midline to obtain a more accurate delineation of the caudal canal. It was found that the apex of the caudal canal hiatus was situated at the 3rd sacral segment in 46 per cent of the cases and below the 3rd sacral segment in 32 per cent. In 66 per cent of the cases the anteroposterior diameter was between 2 and 5 mm. In 50 per cent it measured between 3 and 4 mm. and in 18 per cent it measured less than 2 mm. There was found to be a direct correlation between these findings and the ease with which the canal was entered. In 6 cases or 12 per cent, no hiatus was apparent on the film, and it was believed a complete bony block of the opening of the caudal canal existed. Variation in size of the intertuberosity diameter was not marked or significant. In 6 per cent of the cases no opening of the caudal canal was revealed on the anteroposterior films. This differed from the results as viewed on the lateral planigraphic films, but was explained by the lack of depth of the hiatus and the possible distortion of the film.

In 10 per cent of the cases small apertures were seen in the posterior wall of the caudal canal. In 14 per cent the cornua were flat or absent. A completely blocked lumen of the canal at the opening was noted in 10 per cent and a partial block either at the opening or above was observed in 14 per cent of the cases. The sacrum appeared to deviate from the midline in 6 per cent of the cases and there was an exaggerated sacral curve in 16 per cent.

When observations were made on the patients after caudal anesthesia was attempted, it was found that 8 cases, or 16 per cent, were unsuccessful cases because of the inability to introduce the needle into the caudal canal. Most of these cases had roentgenographic findings that showed a complete block of the lumen or an absence of the lumen.

A method of x-ray study of the sacrum with special reference to the caudal canal was thus presented. The studies indicated the importance of preliminary roentgenological investigation prior to the attempt to produce caudal analgesia. The significant anatomical findings contributing to unsuccessful analgesia were a narrowed anteroposterior diameter, absence of the hiatus, a blocked lumen and angulations of the posterior wall of the caudal canal.

MARY KARP, M.D.

Newton, C. W., Jr. and Andros, G. J. Continuous Caudal Analgesia in Curettage for Abortion. *Am. J. Obst.*, 1945 50 430

In an attempt to decrease the blood loss at the time of therapeutic abortion and curettage for incomplete abortion, the authors have used continuous caudal analgesia as an anesthetic method. This technique maintains tonicity of the uterine muscle and at the same time provides analgesia of the perineum, vagina, and of the cervical and fundal portions of the uterus.

In 22 consecutive cases the average blood loss was less than 40 c.c. per patient, varying from less than 5 c.c. to 125 c.c. Seventeen of the patients lost 50 c.c. or less. There were no anesthetic, operative, or postoperative complications. Postoperative convalescence and return to normal activity of the patient is hastened.

EDWARD L. CORWELL, M.D.

Roman, Vega, D. A., and Adriani, J. The Efficiency of "Oenethyl" (2 Methyl Amino-Heptane) As a Vasopressor Substance for Spinal Anesthesia. *Saudi. J. J.* 1945 38 635

Because aliphatic amines have never been employed for overcoming the hypotension of spinal anesthesia, the authors have been interested in determining the clinical value of such a compound for this purpose. This report comprises experiments with "Oenethyl" in 700 surgical patients with a preliminary report on the first 100 patients. 2 Methyl amino-heptane, or Oenethyl, is a clear volatile liquid which is slightly soluble in water and mildly alkaline. Its vasopressor action is similar to but more sustained than that of epinephrine. It produces a rise in both systolic and diastolic pressure

and an increase in pulse pressure with improvement in heart action, dilatation of the pupils, piloerection, a bronchodilatory action, decrease in renal volume and some stimulation of respiration, but no action on the smooth muscle of the uterus. Its pressor effect is due largely to constriction of the arterioles. Its toxicity is low and it does not appear to have any direct stimulating or depressing action upon the central nervous system. Large doses may cause weakness, lethargy, drowsiness, or prostration, and toxicity is manifested by hypotension and depression of the pulse rate.

Fifty-three per cent of the cases studied received *orphenethyl* prophylactically to avoid anticipated hypotension. In the rest of the cases the drug was given therapeutically to combat hypotension when it appeared. The drug was administered intramuscularly or intravenously, the latter route being chosen when an acute hypotension occurred. The drug appeared to be an effective vasopressor which successfully combated the hypotension of spinal anesthesia in the majority of the patients to whom it was administered. In 3 per cent of the cases it failed to restore the blood pressure to the preoperative level. However, in no case did it fail to cause some elevation.

From 5 to 100 mgm. of the drug were found to be the therapeutic dose for intramuscular injection. When used intravenously the effective dose varied

from 10 to 50 mgm. and the best results were obtained by administering the drug slowly in small doses of 10 mgm. each and allowing one-half hour to lapse between the administration of each fraction. Overdose caused an excessive rise in the blood pressure and a temporary disturbance in cardiac rhythm.

Venopressor studies on 6 subjects showed a lowering of pressure to preanesthetic levels. There was no significant alteration in pulse rate. Tachycardia was not observed at any time. Fifteen per cent of the patients demonstrated pupillary dilatation which persisted for approximately 30 minutes. Transient dizziness was found in about 25 per cent of the cases and nausea and emesis in 5 per cent. The onset of the pressor effects occurred in about 2 minutes after the drug was administered intravenously and from 3 to 5 minutes when it was given intramuscularly and as a rule the effect was maximal 10 minutes and was sustained for the duration of the operation following a single injection.

In 25 patients the drug was a (musclemen) and ephedrine sulfate had failed to restore the blood pressure to satisfactory levels and in all of these cases the blood pressure rose satisfactorily.

The authors concluded that "*orphenethyl*" is to be a satisfactory vasopressor for spinal anesthesia and recommended its further clinical trial.

BY KAY M.D.

PHYSICO-CHEMICAL METHODS IN SURGERY

ROENTGENOLOGY

Krause, G. R.: The Roentgen Diagnosis of Pulmonary Infarcts. *Radiology* 1945 45 107

Roentgenologically a pulmonary infarct may mimic any other lung disease and be interpreted in correctly more often than any other pulmonary lesion. This may be due to its supposed rarity.

The author reviewed 344 cases of lung infarct which were seen at autopsy. The infarct was the direct cause or major contributory cause of death in 174 cases and in only 22 per cent of that number was it diagnosed correctly. In 73 cases clinical and roentgenological correlation with postmortem findings was adequate.

The literature reviews many positive roentgen findings of pulmonary infarct. Wharton and Pearson (1922) described clouding in the costophrenic angle as an early sign of infarct. Wessler and Jaches (1923) described the triangular shadow with the base toward the axilla. Smith (1938) described 6 signs of infarct: hazy, horizontal, clouding at the base, the suggestion of pleural effusion, increased circular density with cavity formation, dense linear shadow and basal collapse of a lobe. Westermarck (1938) described the area of avascularity in the region of the embolus. Jellen (1939) stated that an infarct may not be apparent for several days following the embolic process.

The majority of infarcts occur in cardiac and postoperative patients. Clinical findings of pulmonary infarct are sudden, sharp pleural pain and dyspnea, moderate elevation of the temperature and white blood count, with a gradual return to normal within a few days if the patient survives. Chilling is almost never present. The physical findings are rales, change in breath sounds and friction rub.

Most infarcts occur in the right lower lobe; they are frequently multiple and their average size is from 2 to 6 cm. The shape of the infarct tends to follow the lung contour and is not characteristic. Superimposition of infarcts may also cause a variation of the shape.

Complications of pulmonary infarct are secondary bronchopneumonia, pleural effusion, lung abscess and pulmonary pleural fistula. These complications obscure the detail and make the interpretation much more difficult.

Healing of infarcts does not occur by resolution. The necrotic tissue is replaced by fibrous tissue which results in scar formation and may be stellate or linear in type.

Infarcts must be differentiated from lobar pneumonia, bronchopneumonia, atypical pneumonia, tumors, passive hyperemia, pleural effusion, cysts and plaques of atelectasis.

In lobar pneumonia the pulmonary involvement is greater than that in the presence of an infarct.

Within a 24 to 48-hour period it may spread rapidly in spite of good clinical response to chemotherapy. In bronchopneumonia the involvement in the bases is multiple patchy and mottled. Atypical pneumonia resembles bronchopneumonia. Primary pulmonary tumors with resultant collapse of the lung can best be demonstrated by overexposed Bucky films. Passive hyperemia causes a dense bilateral linear shadow in the hilum radiating to the periphery with a gradual fading. Pleural effusion may be either free or encapsulated. Free fluid occurs in the lower lateral portion of the lung field with a smooth curved upper border and a convexity inferior. The superior border of an infarct in this area is straight with a convexity upward. Infarcts are never elliptical as in interlobar effusions. Air filled or fluid level cysts present no diagnostic difficulty; however cysts filled with fluid do. These rarely occur against a pleural surface and are almost spherical in shape. Plaque or disk atelectasis may be difficult to distinguish from an early infarct. However within a few hours the picture will have changed so that a diagnosis of atelectasis may be eliminated or confirmed. All infarcts leave scars and reach the pleural surface at some point; they may be multiple, are found at different planes and are shorter than atelectatic plates.

Since pulmonary infarcts may mimic any other lung lesion it is essential to analyze the roentgen and clinical data carefully for the welfare of the patient. If this is done, an accurate diagnosis of pulmonary infarct will be expedited with prompt institution of adequate therapy. MAURICE D. SACHS, M.D.

Thomas, S. F.: The Value of Gastric Pneumography in Roentgen Diagnosis. *Radiology* 1945 45 128

Although the importance of gastric pneumography localizing a mass in the body or tail of the pancreas has been stressed by previous writers to date very little attention has been paid to this useful procedure as a means of localizing tumors in the upper abdomen.

For the purpose of distending the stomach the author modified the original technique of Engel and Lysholm by using a small calibered stomach tube instead of effervescent powders. The quantity of air injected varied from 300 to 800 c.c. The patient lies prone with high supports under the pelvis and chest. The x-ray beam is horizontal and a vertical Bucky diaphragm is used.

The normal retrogastric space is equal to the depth of the first or second lumbar vertebra. Caution must be exercised in removing all fluid and food contents from the stomach prior to the installations of air or diagnostic errors may ensue. Aside from pancreatic pathology the retrogastric space may be increased by obesity, ascites, liver tumors, meta-

treated patients, 30 per cent were symptom free one year after therapy.

The authors emphasize that an early diagnosis and prompt orthopedic and x ray therapy will yield the best results.

MAURICE D. SACHS, M.D.

MISCELLANEOUS

Jollis, B.: The Causes and Prevention of Radiotherapeutic Edema of the Larynx. *Brit J Radiol.*, 1945 18 378.

The author correlates the available data which have an influence on the complex problems of edema of the larynx and draws certain conclusions as regards preventive or therapeutic measures.

Physiopathology. There are multiple factors upsetting the normal equilibrium between tissue spaces and the bloodstream such as (a) permeability of the membranes (b) osmotic and diffuse potentials (c) lymphatic and venous obstruction and (d) organ activity as for example edema surrounding the salivary glands. The last is of particular interest when the edema occurs in the neck undergoing radiation treatment. Other factors are (1) infection (leucotoxine), (2) predisposing factors as plethoric hydremia (3) milieu interieur in which the acids resulting from a breaking down of inflammatory or neoplastic tissue lead to the production of edema. (4) sensory nerves and sympathetic local anesthesia which prevents or diminishes edema. (5) hormones adrenalin-decreasing permeability and acidification, and (6) decreased extravascular pressure.

Anatomy. The term edema of the glottis is a misnomer since most of the edema occurs in the aryepiglottic folds. Weintraub who made an extensive study of the connective tissues of the neck describes—apart from the ordinary subcutaneous connective tissue—3 varieties of connective structures: (1) a membranous periorganism of lamellar sheetlike connective tissue, which forms the adventitial covering of various organs and structures, (2) areolar or shearing connective tissues which form the anatomic or surgical spaces and lie between moving parts and (3) nerve-vessel carrying tissues which are intermediate in their physical consistency between the areolar and membranous varieties.

The second variety plays the most important role in edema of the neck.

Radiobiology. There is always a lag between the irradiation and the first biochemical and histological changes corresponding to the clinical latent period. The variations of ions in the blood of irradiated persons and their effect on edema are shown in Table I.

The many other factors which may influence the edema as the result of irradiation are grouped schematically in Table II.

Treatment of edema. As may be seen a rather gloomy picture is obtained in regard to the chances of treatment of radiotherapeutic edema. Nevertheless certain measures may prove of clinical benefit. A mixed diet with adequate protein content is essential. Histaminase and vitamin C should be tried.

TABLE I.—VARIATIONS OF IONS IN THE BLOOD IN IRRADIATED PERSONS

X-ray transmembranalization	Edema favoring and preventing factors
Cations	
N increased	N edema favoring factor
K increased	K edema favoring factor
Ca decreased	Ca edema preventing factor
Anions	
Phosphate increased	Phosphate edema preventing factor
Bicarbonate decreased	Bicarbonate edema preventing factor
Cl decreased	Cl edema favoring factor
Decrease in anions—more acid values	(N Cl edema favoring factor) as transitory effect

Foci of infection should be attended to. Alkaline gargles (collintorium phenolis alkalinum) seem advantageous in conjunction with alkaline mixtures per os and 10 per cent calcium gluconate given intravenously. For the combating of pain spraying of the throat every 4 hours with a solution of urethane 1:6 in water with 1 per cent ephedrine, 1 per cent cocaine and a few drops of peppermint is recommended.

TABLE II.—OTHER FACTORS WHICH MAY INFLUENCE THE EDEMA AS THE RESULT OF IRRADIATION

Edema producing factors	How affected by growth	How affected by X-rays
Damage to vessel wall	F	F F edema
Capillary dilatation	F?	F favoring
Ascoria	F	F factor present
Increased hydrostatic pressure (passive)	F	F
Adrenella deficiency	F	F
Infection	F	—
Inflammation	F	F
Pain (via sympathetic)	F	F
Lymphatics	F	F
Venous obstruction	F	F?
Organ activity (general)	F	F
Organ activity (specific)	F	F
Extravascular pressure	—	F
Scurrag	—	F
Predisposing regional factors	F	F
Diffusion potentials	F	F
Metabolites	—	F
pH	F	F
Endocrine	F	F
Irradiation	F	F
Histamines	F	F

mended. Some patients object to the bitter taste of the spray but all of them agree that they feel much better with the spraying than without it.

T. LEUCUTIA, M.D.

Lawson, F. E.: Gall Bladder Dye (Iodophthalein Sodium); Effect of Intravenous Injections on the Coronary Flow, Blood Pressure, and Blood Coagulation. *Arch. Int. M.*, 1945, 76: 43.

The dangers of intravenous cholecystography have been cited in the literature since 1915. A review of this literature by the author reveals that most of the patients sustained coronary arterial occlusion. One case of syncope with loss of the feces and urine was reported. Consequently cardiovascular disease was regarded as the chief contraindication.

The author adds his experience with 4 cases. Two of these are classed as anaphylactic shock mainly because the fall of the blood pressure responded to epinephrine and to conventional shock therapy. One of the patients complained of substernal pain, which was not relieved by theophylline ethylenediamine but serial electrocardiograms were negative.

The other 2 accidents are considered by the author as having been caused by coronary occlusion. Both patients showed electrocardiographic changes compatible with or indicating myocardial infarct. One patient died 24 days after the administration of the gall bladder dye (which in this case was given orally in contradistinction to the other cases). Both patients were known to have suffered from angina pectoris.

The following experiments were made in connection with this problem.

1. Measurement and kymographic registration of the coronary blood flow with the Morawitz cannula and of the carotid arterial pressure in 4 dogs, before, during, and after the intravascular injection of gall bladder dye. The dose was proportionate to that given to human adults. The injection caused a fall of the blood pressure and an increase of the coronary flow in all of the cases.

2. Determination of the influence of the gall bladder dye (iodophthalein sodium) on the coagulability of the blood of 7 human subjects by means of the De Takáts heparin tolerance test. In 4 cases the coagulation time was increased and in 3 cases it was decreased. The blood pressure dropped in 5 patients and remained unchanged in 2.

The author draws the following conclusions:

1. Iodophthalein sodium produces an increase in the coronary blood flow in dogs.

2. It causes the blood pressure to drop in human beings and in dogs.

3. The fall in blood pressure may explain the mechanism of shock which the author had occasion to observe twice.

4. The mechanism causing coronary arterial occlusion is not clear.

5. The intravenous injection of iodophthalein sodium is contraindicated in persons with coronary arteriosclerosis (if for no other known reason than the drop in blood pressure it causes).

GERHART S. SCHWARTZ, M.D.

MISCELLANEOUS

GENERAL BACTERIAL, PROTOZOAN AND PARASITIC INFECTIONS

Vinnard R. T.: Three Hundred and Fifty Two Cases of Tetanus. *Surgery* 1945 18 482.

Among 352 patients with tetanus treated from November 1 1934 to October 31 1944 the total mortality was 45 per cent excluding the deaths which occurred in the first 36 hours the net mortality was 34 per cent. In the past 3 years the mortality rate was substantially reduced (a total mortality of 31 per cent and a net mortality of 18 per cent). Routine immunization by means of tetanus toxoid among the population of tetanus-prevalent areas as effectively practiced by the Armed Services in World War II is highly desirable.

Reduction in the mortality rate would also be furthered by the following procedures: 1. Routine administration of prophylactic antiserum (preferably 3,000 or more units) in the treatment of all injuries to patients who have not previously received toxoid immunization. 2. Education of lay people to report early and of doctors to recognize and institute immediate therapy for symptoms of early tetanus. 3. Immediate intravenous administration of adequate amounts of antiserum. 4. Complete excision or debridement of all possible foci of infection including umbilicectomy in cases of tetanus neonatorum. 5. Adequate sedation. 6. Therapeutic doses of sulfonamides to prevent secondary infection and as prophylaxis against pneumonia. 7. Daily intramuscular administration of from 40,000 to 50,000 units of antiserum to all patients in whom the original foci of infection cannot be found or be completely removed. 8. Good nursing care. 9. Adequate caloric and fluid intake by means of stomach tube feedings. WALTER H. NADLER, M.D.

MacFarlane, R. G., and MacLennan, J. D.: The Toxemia of Gas Gangrene. *Lancet*, Lond. 1945 249 318.

The clinical features of toxemia in gas gangrene have been described. A "collagenase" has been identified in clostridium welchii toxin and its significance in gas gangrene discussed. The possibility that the general toxemia of gas gangrene is not due to alpha toxin but to the products of tissue breakdown has again been studied, particularly in animals. Some evidence in favor of this theory has been obtained. A possible relationship between the toxemia of gas gangrene and that seen in other forms of shock has been noted.

MacLennan, J. D., and MacFarlane, R. G.: Toxin and Antitoxin Studies of Gas Gangrene in Man. *Lancet* Lond. 1945 249 301.

By the lecitinase reaction it is possible to make sufficiently reliable titrations of alpha toxin of

clostridium welchii and its corresponding antitoxin for observations in the field.

As diagnostic procedures in early gas gangrene neither the lecitinase nor the hyaluronidase test has proved satisfactory.

In 4 of 27 cases of gas gangrene—almost all of them caused by clostridium welchii—free alpha toxin was detected. In only 1 instance, however, was a positive reaction obtained with material taken during life. WALTER H. NADLER, M.D.

Hall, I. C.: The Occurrence of Bacillus histolyticus in Accidental Wounds without Recognized Specific Infection. *Surgery* 1945 18 369.

The comparatively infrequent demonstration of bacillus histolyticus in accidental wounds probably gives an erroneous conception of the true frequency of its occurrence. This bacillus is easily overlooked in a bacteriological examination of a mixed infection. On media the organism grows in minute colonies that are likely to be overlooked in a mixed culture by all but the best trained and most meticulous bacteriologists. This accounts for the fact that, although widespread in nature, the bacillus histolyticus was not discovered until 1916.

Pure infections with this organism are rare. The typical lesions produced by pure infections of bacillus histolyticus are most often masked in cases with mixed infections and therefore not recognized.

The bacillus histolyticus was demonstrated in cultures taken from the debrided tissues in 17 civil wounds. There were 7 compound fractures, 5 lacerations, 3 gunshot wounds and 2 burns. This was believed to be the first time that this organism was demonstrated in burns. DAVID H. LYNN, M.D.

Willett, F. M. and Weiss, A.: Coccidioidomycosis in Southern California: Report of a New Endemic Area with a Review of 100 Cases. *Ann Int Med.* 1945 23 349.

A new and rather large endemic area of coccidioidomycosis is reported with this review of 100 cases. The region is roughly triangular bounded by Banning and Needles, California, and Yuma, Arizona. Following admission of a number of cases of the disease to the March Field Station Hospital repeated skin tests were made on 573 soldiers representing both white and colored troops who were performing a dusty type of work at the edge of the desert. In 135 men a "change over" from negative to positive skin reaction was found. Of these men 83 were hospitalized with acute pulmonary coccidioidomycosis. The remaining 52 had insufficient findings to warrant hospitalization and were eventually classified in the clinically inapparent group. These findings established the fact that a considerable part of this desert area was endemic for coccidioidomycosis.

The cases reported here presented no diagnostic problem, since 83 were found as a result of the epidemiological survey and 17 additional cases came from the desert area. The history shows residence assignment, travel, or recent activity in a known or suspected area. A suggestive history in the presence of a pulmonary ailment requires consideration of coccidioidomycosis in the differential diagnosis. By far the greater number of initial infections with coccidioidomycosis are of the inapparent or asymptomatic type. In decreasing order of frequency the symptoms occurring in 100 cases of pulmonary coccidioidomycosis were fever, chest pain, cough, malaise, anorexia, headache, pharyngitis, chills, cutaneous manifestations, joint pain, conjunctivitis, and hemoptysis. Physical examination is only moderately helpful in the diagnosis. Most of the patients are obviously suffering from a respiratory infection without specific physical findings. Unless there are skin or joint manifestations, the physical signs are not revealing. Roentgenograms are of great help both in the diagnosis and in following the course of the disease. The roentgenological findings may be roughly divided into the following categories: (1) varying degrees of parenchymal infiltration, (2) hilar adenopathy and thickening, (3) fluid, (4) nodule densities, (5) cavitation and (6) bone lesions.

The skin test is probably the most helpful single test when used in conjunction with other aids, i.e., travel history, roentgenograms, sedimentation rate, differential blood count, and serological studies. Failure to react to coccidioidin used as an intradermal skin test in a concentration of 1:100, rules out the possibility of coccidioidomycosis provided sufficient time has elapsed to permit the individual to develop the necessary sensitivity except in those patients with disseminated infections. Serological studies were of inestimable value both in making a definite diagnosis and in following the course of the disease. Dissemination was predicted before it occurred in every case by serological tests on the basis of high titers in complement fixation. This was not based on the reaction to the skin test which in 1 instance of dissemination was completely negative. The declining antibody titer was used as an index of safety in mobilization of the patient. The differential and total leucocyte count was of interest mainly because of the eosinophilia, which varied between 5 and 18 per cent of the total leucocyte count. The erythrocyte sedimentation rate was of considerable value, being increased in all patients and varying between 16 mm./hr. and 46 mm./hr. This test was useful both in diagnosis and prognosis. The impression was obtained that sputum examination in the diagnosis of coccidioidomycosis is not an entirely satisfactory method of diagnosis.

Cavitation and dissemination are the two main complications of the disease. The latter is of far greater importance than the former although probably less frequent. In 3 cases of cavity in white sol-

idiers one cavity closed and the other showed a strong tendency toward closure, while in 4 cases of cavity in negroes only 1 cavity closed. Despite the conservative treatment accorded the patients in this series, dissemination occurred in 4 patients, all of whom were colored soldiers with complete bed rest. One of the cases terminated fatally with a generalized miliary dissemination.

The average case of acute pulmonary coccidioidomycosis has an extremely good prognosis for complete recovery. Barring dissemination or complicating cavitation, the average case is almost in the class of a self-limited disease when given proper treatment. The main essential of treatment is adequate bed rest, and until the condition is markedly improved the should be absolute bed rest. The criteria for return to duty were based on the clinical findings, roentgenograms, sedimentation rates, serological studies and absence of evidence of dissemination. Illustrative cases are presented.

JOHN L. LAMBERT, M.D.

Ory, E. M., Meads, M., Brown, B., Wilson, C., and Finland, M.: Penicillin Levels in Serum and in Some Body Fluids during Systemic and Local Therapy. *J. Lab. Clin. M.* 94:30-34.

The rational choice of dosage and route of administration of penicillin presupposes some acquaintance with the effective concentrations of the antibiotic which can be attained and maintained at the site of the infection by the different methods. The desired concentration in any given case will depend, of course, on the susceptibility of the infecting organism. This communication deals with the concentrations of penicillin obtained in serum and in certain body fluids of adult medical patients after the administration of various doses of commercial penicillin by different routes. The data were obtained almost entirely on patients while they were under treatment. The method used is subject to considerable error, but it is adequate for these purposes since it was not intended here to offer any accurate measures of the absorption and fate of penicillin in the body.

The concentrations of penicillin which destroy the common bacteria encountered in medical infections were studied by the authors by a very standard method so that the results are comparable. They indicate that the smallest concentration of penicillin which was measured in the present study, namely 0.03 unit per cubic centimeter, is adequate to sterilize actively growing cultures of almost all strains of the gonococcus group A hemolytic streptococcus, about half of the strains of the meningococcus, and a somewhat smaller proportion of the strains of the pathogenic staphylococci. Undoubtedly the accessibility of the penicillin to the organism and many other factors, most of which are still unknown, come into play and account for some of the discrepancies between the *in vitro* and *in vivo* results.

The serum levels of penicillin obtained after various doses and intervals during systemic administration indicate that for any given dosage only a

MISCELLANEOUS

of levels rather than any specific values can be obtained. In general, higher levels are attained and maintained with the larger and more frequent doses. Levels are not directly proportional to the amount given in the dose except possibly in any given individual under constant intravenous therapy. The results in patients with cardiac or renal insufficiency indicate that the volume of urinary output and the rate of the kidney function may materially affect the height and persistence of penicillin levels after a given dose. Such patients usually attain and maintain any given level with appreciably smaller doses given at longer intervals than do persons with normal renal function and those who excrete larger volumes of urine.

The problem of whether or not topical injections are necessary in cases of meningitis, infection of the serous cavities, or walled-off focal abscesses will be answered more directly on the basis of clinical results than by any analysis of data such as those given in this article. The present observations and similar studies by others indicate that there is some diffusion into all serous cavities but that this is erratic and usually only slight. Clinically, it is already recognized that these infections after they have been established do not often respond to systemic treatment alone in spite of the fact that bacteriostatic concentrations for the offending organisms can often be demonstrated in the exudate.

In cases of meningitis there are differences expressed in the literature, both as to the penetration of penicillin into the cerebrospinal fluid and as to the necessity for having such penetration. Small amounts of penicillin have been found by others in individual cases particularly after massive systemic doses. This has not been the authors' experience nor that of others who have used larger doses in a greater number of cases. Some cases of bacterial meningitis have been reported as cured without resort to intrathecal injections of penicillin but these cases are not entirely convincing since few if any of the patients had received systemic penicillin as the only specific therapy. On the other hand the experience in the authors' clinic and in many other clinics indicates that not only is intraspinal therapy necessary but in some instances it is necessary to resort to injections into the cerebral subarachnoid space or even into the ventricle for complete recovery.

The necessity for systemic treatment when penicillin injections are given into infected body cavities will depend on the circumstances in each case. Some absorption takes place from all the cavities, but this is too erratic and therefore the effective levels are sustained in the circulation for variable periods. Some workers have found the poorest absorption from thick walled cavities and from abscesses which are walled off. Obviously therefore if there is evidence of infection of tissues away from the infected cavity into which the penicillin is being injected systemic treatment is definitely indicated. The absorption from the cavity may however be adequate

to protect against spread of the infection from the site of the injection as a result of the procedure. It is possible that diffusion out of cavities is given at the same time and that may be a reason for using it. Evidence for this, however, is scant.

BENJAMIN GOLDMAN, M.D.

DUCTLESS GLANDS

King, B. T., and Rosellini, L. J. The Treatment of Acute Thyroiditis with Thioracil. *J. Am. Med. Ass.*, 1945 129 267

A series of 11 cases of acute thyroiditis is reported in which cure was effected in 8 by the administration of thioracil. Initially the drug was tried experimentally on a woman who complained of increased nervousness and irritability and who was found to have an acutely swollen and tender thyroid gland, a temperature of 99.6 and an elevation of the white blood count. After receiving 0.2 gm of thioracil t.i.d. for 7 days she was well and free of symptoms, although the thyroid gland remained enlarged and indurated. Continuation of therapy with dosages of 0.2 gm of the drug daily for two weeks resulted in return of the gland to normal size and consistency. The patient was subsequently observed for 4 months with no change in her condition.

Although penicillin has not been employed other methods have proved ineffectual in the treatment of acute thyroiditis. Iodine, rest, hot applications, ice bags, and sulfonamides were of no value. Although x-ray radiation was found definitely to shorten the duration of the disease varying degrees of hypothyroidism and myxedema have resulted from this procedure in a discouraging number of cases. Bacterial cultures of diseased thyroid tissue removed by surgery have never been positive, but it was intimated that the possibility of virus etiology of this condition deserved investigation with possible bearing on the mode of action of thioracil.

Cases for the series were carefully selected 7 cases of acute thyroiditis being included with 3 cases of migrating thyroiditis (the acute process beginning in one part of the gland and spreading to the rest) and 1 case of Hashimoto's struma. Cases of toxic goiter and 1 case of Hashimoto's struma and goiter suppurative thyroiditis, Riedel's struma and longstanding colloid and adenomatous goiter were not included. The diagnosis of acute thyroiditis a clinical rather than a pathological one was made on the basis of enlargement, tenderness and firmness of the all or part of the thyroid gland together with the clinical findings mentioned in the previous case history.

In the 8 cases cured the treatment was continued for 3 weeks or less. All of the patients were symptom free in one week, and in all the glandular enlargement and tenderness disappeared. In 1 case treatment had to be terminated before the 3 weeks were up because of intolerance to the drug, but nevertheless this case was included in the group of cures. In 2 of the 3 other cases treated with thioracil the

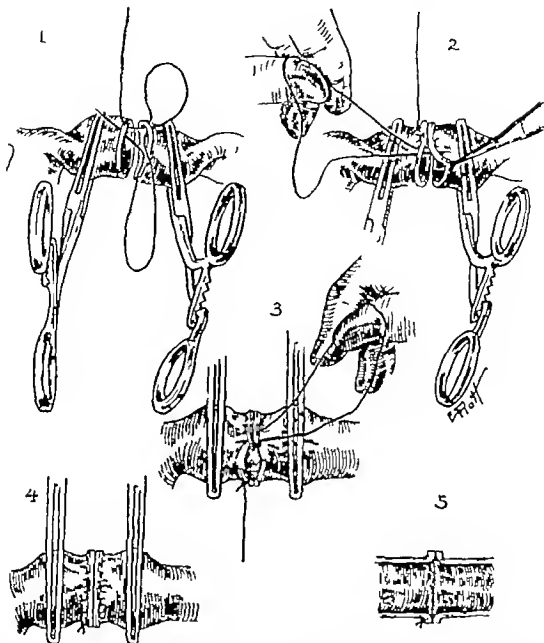


Fig. 2. Details of the end-to-end suture of the divided aorta. 1. The aorta is temporarily rotated so that the back wall can be stitched first. 2. The back wall is sutured with a continuous, everting stitch that includes the full thickness of the aortic wall. 3. The aorta is allowed to rotate back

into normal position, the back wall suture being complete. 4. The stitch is carried around onto the front wall. 5. The anastomosis is complete, the edges of the aorta are everted. 6. A cross section shows that the intima of the upper and lower segments are in contact with each other.

luminal clotting at the site did not prove to be a serious factor with the method of suture illustrated. A serious complication of these operations was hind quarter paralysis. Studies of this complication were made by occluding the aorta in 20 dogs for varying periods of time, and it was found that paralysis did not develop when the aorta was obstructed for less than 10 minutes.

Two human patients have been operated upon for coarctation of the aorta. One of them survived, the other died with an uncontrollable dilatation of the heart following removal of the clamps. This emphasizes the importance of slow removal of the aortic clamps.

It is concluded that it is technically feasible to remove a narrowed portion of the aorta in man.

to re-establish aortic continuity by the method described
JOHN L. LINDBLUM, M.D.

Grimm, P. D., and Martos, V. F.: Studies in Oleothorax. The Bacteriostatic Action of Oils on the Tubercle Bacillus. *J. Thorac. Surg.* 1945 14 265

Several of the unsaturated fatty acids have been reported to be bactericidal for the tubercle bacillus. In this experimental study the authors found that cod liver oil and peanut oil have no effect on the virulence of the tubercle bacillus.

The difference between these results and those of other investigators may be due to a marked difference in the resistance of the bacterial strains used (by the other workers and the authors) to cod liver oil, or to a difference in the oils employed. It is possible that the oils available today are more highly purified than those of a decade ago, and have been freed from the substances responsible for the bacteriolytic action.

Casein was included in this study because it has been used extensively in disinfection oleothorax. Cod liver oil and peanut oil were studied because of the reports of their inhibitory effect on the tubercle bacillus. The authors concur that these oils have an inhibitory action on the growth of the tubercle bacillus. However the subsequent growth of the organisms on a rich medium and their normal virulence when injected into guinea pigs indicate that the oils adherent to the tubercle bacilli inhibit their growth by a physical rather than by a chemical action.

JOHN E. KIRKPATRICK, M.D.

Grimm, P. D., and Westra, J. J.: Studies in Oleothorax. The Use of Oils in Disinfectant Oleothorax and in the Re-expansion of the Lung in Tuberculous Empyema (Preliminary Report) *J. Thorac. Surg.* 1945 14 270.

Oleothorax with peanut oil and cod liver oil has definitely established its value in controlling tuberculous infection of the pleura. Further treatment of the empyema space is determined by the condition of the lung. The authors have found that an oleothorax of irritant oils produces an obliterative pleuritis and seals over the subpleural foci of infection. If the visceral pleura is not too thick and the lung shows a tendency to re-expand, an uncontaminated infection in the lung can be given priority and the oleothorax continued. When the parenchymal lesion is sealed, the lung may be allowed to re-expand. The lung gradually re-expands if assisted by the periodic removal of oil and air if they are present, and by the maintenance of negative intrapleural pressures. If the lung does not re-expand entirely a less extensive thoracoplasty than would otherwise be necessary can be performed. Thus early use of irritant oils may obviate the mutilating Schede procedure.

In the conduct of oleothorax, frequent examination of the patient with periodic removal of pus or fluid, and maintenance of negative intrapleural

pressures, is mandatory. This avoids empyema or escape of oil through a needle opening and diminishes the chances for the formation of a bronchial fistula. There is great individual variation in the rate of fluid or pus formation, and disappearance of the tubercle bacilli. Oil and a little fluid, with or without bacilli, can be present in the chest for an indefinite period without clinical symptoms. One patient with diabetes, a very poor surgical risk who had a tuberculous empyema, carried cod liver and pus in the pleural space for 6 years before a bronchial fistula developed. This patient failed to report for aspirations during this time and increased tension helped to cause the fistula.

With oleothorax, the surgical problems of aspiration are diminished and closed drainage with empyema tubes and catheters is eliminated. The authors have always considered open drainage contraindicated unless a bronchial or pleural fistula is present. Of 50 patients with varying degrees of purulent effusion and empyema, 6 experienced re-expansion of the lungs without reactivation of the pulmonary infection or further plastic operation for closure of the pleural space. Of the remaining 14 patients 10 now have oleothoraces which are negative for tubercle bacilli. Re-expansion of a lung may be lifesaving to the patient if a tuberculous infection develops or is present in the other lung as it was in 11 cases of this series. The use of irritant oils in oleothorax adds a reversible procedure to the treatment of tuberculous empyema, which heretofore has often demanded an irreversible one.

JOHN E. KIRKPATRICK, M.D.

Zerbin, E. D.: The Importance of Ascorbic Acid (Vitamin C) in Chest Surgery *J. Thorac. Surg.* 1945 14 309.

The closure of the bronchi after partial or total resection of the lung and the gastroesophageal anastomosis still constitute two important problems in thoracic surgery. Defective cicatrization frequently occurs in both cases and results in a bronchial or esophageal fistula. The surgical technique employed in the procedure is very important in the prophylaxis of these complications and in obtaining a good scar, but the technique constitutes only one of the factors influencing scar formation. In many cases it is impossible to obtain a good suturing because of local conditions, but even with the best technique the disruption of the sutures from lack of scar formation, may occur.

The amount of ascorbic acid in the blood and in the tissues has been considered one of the most important factors in the formation of the intercellular collagenous tissue and in the strength of the scar both in animals and in human beings. The amount of ascorbic acid in some patients was studied by the author before and after lobectomy, pneumonectomy, and esophageal resection. The blood proteins of these patients were tested continuously because hypoproteinemia is another important factor in scar formation which should always be corrected.

The chest condition which brings the patient to the hospital may be responsible for a low plasma ascorbic acid level before the operation. In 22 patients examined the average level found just after admission was 0.15 mgm. per cent of plasma ascorbic acid (normal considered between 0.8 to 1.2). Only 1 patient had a normal blood level before operation and 9 patients showed complete absence of ascorbic acid in the plasma.

The operation by itself reduces considerably the plasma ascorbic acid, according to the severity of the surgical procedure. This level remains low during a long or short interval according to the postoperative complications and treatment.

The author found that it is possible to maintain an almost normal plasma ascorbic acid level before and after the operation with the administration of 1,000 mgm. of ascorbic acid every 24 hours.

The determination of the white cell platelets ascorbic acid gave different results in different patients. When the general condition was good and the patient was a good risk, the white-cell platelet level did not change with the operation, even when the plasma level was zero. In one patient with esophageal cancer and artificial alimentation through a gastrostomy the plasma and white-cell platelets were both found deprived of ascorbic acid, a condition which represents a prescorbutic state without clinical evidence.

The amount of ascorbic acid in muscle and lung tissue removed during the operation seems to be below the values considered as normal by different authors.

The author draws from his studies the conclusion that all patients with chronic surgical chest conditions should be given high doses of ascorbic acid before and especially after important surgical procedures.

JOSEPH K. NARAT, M.D.

Harper W. H., and Blain, A., III: The Effect of Penicillin in Experimental Intestinal Obstruction. *Bull. Johns Hopkins Hosp.*, 1945 76 3

The purpose of this study was to reinvestigate the role of bacteria in producing death in dogs having isolated, obstructed jejunal loops, since antibacterial agents were not available to earlier workers in this

field. Potent antibacterial agents, especially penicillin, having no known important chemical or other reaction on the body were used. In studies on the problem of "toxemia" in relation to intestinal obstruction the use of the isolated obstructed loop is valuable because the factors of pancreatic juice, bile and decomposed food substances are eliminated, loss of electrolytes and water by vomiting largely obviated and the blood chemistry remains normal or nearly normal. The factors which remain and can be evaluated are the presence of bacteria, stasis, and distention.

In all dogs a portion of jejunum about 15 cm. in length was resected and its blood supply was left intact. Intestinal continuity was restored by end-to-end suture. Specimens for bacteriological study were obtained from the loop, which was then washed free of gross intraluminal material and closed at both ends by inversion. Fifteen dogs received no penicillin therapy and were used as controls. In 15 other dogs 50,000 units of penicillin in 4 c.c. of saline solution were introduced into the loop before it was closed, and 5 additional dogs were given large doses of penicillin intramuscularly starting at the time of operation.

All of the control dogs with isolated, obstructed high intestinal loops died within 6½ days. All of the 15 dogs in whose isolated loops penicillin was introduced were protected for 9 days, while 93 per cent were protected for 13 days, and 66 per cent were protected for over a month. Five dogs treated parenterally with penicillin were protected for more than 18 days.

Marked distention of the loop occurring in the presence of bacteriostatic agents is compatible with life. In the absence of distention of the loop as abundant bacterial flora uninhibited by bacteriostatic agents is compatible with life. These experiments indicate that distention must be present before infection of the intestinal wall by the normal intestinal flora can occur.

Microscopic and bacteriological evidence is presented to show that penicillin given prophylactically in large doses can prevent infection of the distended intestinal wall by the normal intestinal bacteria.

JOHN L. LUDWIG, M.D.

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LEIOMYOSARCOMA OF THE STOMACH

Its Roentgenologic and Gastroscopic Diagnosis and Its Possible
Relation to Pernicious Anemia

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LEIOMYOSARCOMA (leiomyoma malignum) is one of the rarest tumors of the stomach. It has been reported (7, 21) to comprise only 10 per cent of all gastric sarcomas. Since the frequency of sarcoma as compared to carcinoma of the stomach is said to be only 1:100 only one leiomyosarcoma should be expected to 1,000 cases of gastric carcinoma. Because we have observed 4 cases within a relatively short period of time, we feel that this statistical data may be misleading and that leiomyosarcoma may not be so rare as has been previously reported.

The diagnosis of this tumor is important because of its good surgical prognosis. The surgeon who may be inclined not to operate on large infiltrative carcinomas must nevertheless, consider the presence of a leiomyosarcoma which has a favorable prognosis and should not refuse to give the patient a chance as long as this tumor cannot be excluded.

It would be most desirable to make the differential diagnosis before laparotomy. The 4 cases observed by us were all examined gastroscopically. Although gastroscopy did not lead to the exact diagnosis the publication

of gastroscopic observations made on these patients seems to be justified because they may aid in better evaluating the gastroscopic findings in the future.

We have collected a total of 94 cases of gastric leiomyosarcoma from the literature. Sixty-eight of these cases were published by Chaffin in 1938 and since then at least 26 additional reports have appeared.

PATHOLOGY

The differentiation of leiomyosarcoma from benign leiomyoma is not easy. Transitions are to be expected theoretically. Cases have been described in which microscopically benign looking tumors had metastasized and thereby unexpectedly behaved like malignant tumors. Borrmann comments on this fact by saying:

Thus we cannot always recognize whether or not certain cells are malignant. None of the 4 cases of our own can possibly be called a simple benign leiomyoma inasmuch as they all show expansive growth not encountered in the simple benign myoma of the stomach.

Benign myoma of the stomach occurs frequently. Rieniets found 43 leiomyomas in 32 stomachs in 200 consecutive autopsies. These submucosal tumors are usually small and sharply circumscribed. Some may grow sub-

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seriously others may grow toward the mucosa and finally protrude into the lumen of the stomach. They may become firmly fixed to the mucosa which often presents deep ulceration however the sharply limited rounded character of the tumor and the fact that it obviously belongs to the submucosal tissue makes it possible to recognize it grossly at once. The evenly rounded character of the tumor effects a recession between its surface and the surrounding mucosa. The recession is crossed in a characteristic manner by mucosal folds which if found all around prove that the tumor does not grow infiltratively toward the surroundings (19). Although transitional forms may occur it may be stated that in none of our four tumors did the gastroscopic observation reveal the typical picture of submucosal benign myoma. Microscopically the benign leiomyoma is composed of highly differentiated smooth muscle fibers.

Frequently malignant leiomyomas will not form metastases for a long period of time, but they quickly break their natural boundaries, grow expansively and partly infiltratively and prove to be fatal. The infiltration never reaches the degree found in infiltrative carcinomas, and frequently a limiting capsule is still present. Occasionally bridging folds may be seen (see our Cases 2 and 3) but they are much less marked than in benign tumors and usually are present only in a small portion of the circumference of the tumor. Most leiomyosarcomas are probably malignant from the beginning on, although sometimes sudden rapid increase in size of a long quiescent growth, with ensuing cachexia may be observed. Microscopically the muscle cells of these tumors are not so fully differentiated and evenly built as they are in benign leiomyomas. The fusiform cells may be shorter or rounded and irregular in form and show many stages of differentiation of the smooth muscle cell and mitotic figures in changing number may be found.

It is known that there are several gross forms of leiomyosarcoma (all of which were encountered in our own material). They may grow into the lumen of the stomach and may then even become pedunculated (Case 3) they may expand within the gastric wall

(Cases 1 and 4) or they may expand into the omentum or neighboring structures (Case 2). There is as little explanation for these different types of growth as there is for the different gross forms of gastric carcinoma. Ulceration of the mucosa covering the tumor is frequent in all forms.

The differential diagnosis between leiomyosarcoma and lymphosarcoma is particularly important because the lymphosarcoma reacts so well to x ray treatment (Buschke) while the leiomyosarcoma requires surgical treatment. In most cases these two forms of sarcomas should not be confused easily: the lymphosarcoma usually infiltrates the entire wall of the stomach, diffusely involving the entire organ (Bockus Schindler 15 16) although sometimes solid circumscribed tumors may occur (13). The leiomyosarcoma grows more expansively but less infiltratively. Exceptions may occur here too so that microscopic examination of a biopsy specimen is finally the best method for institution of adequate therapy.

The differentiation between leiomyosarcoma and carcinoma is more difficult. It has been said that on palpation the leiomyosarcoma has a rubbery consistency as contrasted to the stony hard palpatory sensation caused by carcinoma yet the gross differential diagnosis may be impossible.

Metastases were found in 15 per cent of our collected series. Cameron reports 20.5 per cent, but figures as high as 70 per cent appear in the older literature (Crohn). Metastases occur most frequently in the liver even without evidence of tumor formation in the regional lymph nodes. They occur but rarely in the lungs and bones. The metastatic liver tumors may grow only slowly. Lemon and Broders have seen a patient live 6 years with a metastatic nodule in his liver.

CLINICAL FINDINGS

The three cardinal findings are (1) gastrointestinal hemorrhage leading to anemia (2) epigastric or left upper quadrant pain (3) upper abdominal mass. Each occurred in about 50 per cent of the collected cases. Gastrointestinal bleeding is frequently severe and recurrent. The abdominal pains vary from a

vague distress to a severe ulcer like type of pain. The abdominal mass may sometimes fill the whole abdomen.

Nausea and vomiting do not occur frequently. Weight loss is usually only moderate in amount.

X ray examination and gastroscopy should at least reveal the presence of a gastric tumor. The most important findings will be described in the histories of our own cases. The difficulty in making of the x ray diagnosis will become apparent from our Cases 2 and 4.

In the collected series x ray examination revealed a filling defect in 59 per cent, an extrinsic mass was suspected in 18 per cent, stiffness of the gastric wall was described in 11 per cent, presence of ulcer niche without filling defect in 8 per cent, and in 4 per cent a negative gastrointestinal series was reported. In one case the correct diagnosis of leiomyosarcoma was made and this case will be discussed later in detail.

There are but few gastroscopic reports. Twice (5, 9) the tumor was overlooked at gastroscopy. Lemon and Broders stated that postsurgical recurrence of multiple leiomyosarcoma was seen gastroscopically. The first gastroscopic description of a leiomyosarcoma was given by Schindler and Letendre in 1942 (18).

CASE REPORTS

CASE 1. The gastroscopic picture of this case has been previously described (18). L. Q., a white male 26 years of age, was seen on October 22, 1940 at Billings Hospital, Chicago (Unit No. 251259). For 3 years he had had a gnawing feeling in the epigastrium and attacks of weakness after exertion. Once he had fainted. He had been treated for pernicious anemia; the blood count showed red cells down to 2,800,000 and seemed to have responded to liver treatment.

Physical examination revealed no abnormalities except some pallor. Hemoglobin was 11.6 grams, red blood cells 4,000,000, white blood cells 9,000. Gastric analysis showed 40 units of free hydrochloric acid after histamine.

November 4, 1940 x ray examination of the stomach (Frederick Templeton) revealed the presence of large neoplastic masses. These seemed to be benign but they were so large that one cannot be sure that they are not malignant. Spectacular degree of polyposis.

November 6, 1940 gastroscopic examination (R. S.) report follows: "The whole stomach was seen and the picture was one which I have never seen before (Fig. 1). The angulus was seen and below it there

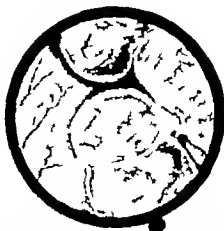


Fig. 1. Gastroscopic picture of leiomyosarcoma. Case 1. Tumor masses protruding from the posterior wall covered by smooth soft mucosa. At 4 o'clock longitudinal ulceration. At the left side atrophic gastric mucosa with blood vessels.

was a soft protruding mass which filled almost the entire antrum. The mucosa covering it showed many dark creases and folds. A dark hole in its upper portion seemed to be the way to the pylorus. Although this mass was unusually soft I would not be able to exclude a malignant tumor from this picture alone. But then other protrusions were seen—5 along the posterior wall and 3 along the lesser curvature. Those of the posterior wall were large hemispherical protrusions which however, sloped gently toward the gastric wall. They all were covered by a smooth and soft mucosa and no stiffness was observed. However the highest of them lying in the fornix, had a somewhat different appearance. Its surface was nodular and had a definitely polypoid character. The three protrusions of the lesser curvature were smaller, the two lower ones having about the size of a cherry and the highest the size of a plum. They were covered by smooth mucosa. Their elevation was partly so that a shadow was cast on the surrounding mucosa but in other portions of the circumference there was a gradual sloping. The uppermost of these three formations contained many nodes of different size and if we had seen this one alone we would not have been able to differentiate between a benign and a malignant adenoma. Its combination with many other tumors speaks for a benign polyposis. The mucosa surrounding the highest of these tumors and of the whole upper third of the stomach was grayish in color with branching blood vessels. It should be mentioned that in the groove between the highest and the next highest excrescence of the posterior wall there was a dark, red, small depression which might or might not have been a small ulceration.

Impression: (1) polyposis, (2) atrophic gastritis of fornix, (3) it is impossible to exclude malignant degeneration of the stalks of the nodes.

On November 11, 1940 an exploratory laparotomy was carried out (Dr. H. P. Jenkins). The

Gastroscopic pictures drawn by Miss Eve Vermeade.



Fig. 3. Gross specimen. Case 1. Nodule mass in posterior wall and lesser curvature. Ulcer.

stomach was opened; extensive tumor masses within the wall of the stomach were found. A biopsy specimen of one of them was taken. Its microscopic examination revealed leiomyosarcoma. Thereupon

a course of x-ray therapy was given with a total of 4,000 r's.

On February 21, 1947, a second operation was performed (Dr. Lester Dragstedt). No change was found in the size of the tumor masses as compared with that at the first operation; the x-ray irradiation had been ineffective. Gastrectomy, splenectomy, partial pancreatectomy, and esophagogastrostomy were carried out. The patient recovered. He received liver treatment and was doing well on September 6, 1947.

Gross specimen. The gross specimen consists of the entire stomach, spleen, and a small portion of the tail of the pancreas. The stomach contains a large, firm mass in the posterior wall and lesser curvature—10 by 6 by 6 centimeters (Fig. 3). It is nodular and firm but not hard. Its serosa is intact and the mucosa is also intact, except over one large protuberant node where it is ulcerated; the floor of the 1 centimeter-sized ulcer penetrates for at least 1.5 centimeters into the tumor mass. Over others of the nodes there are small areas of hemorrhage in the mucosa. The cut surface of the mass is firm, white, with a slight hemorrhagic discoloration at the center.

Microscopically (Figs. 3 and 4) the tumor mass is composed of round and spindle cells with a moderate amount of eosinophilic cytoplasm. There is a slight degree of anaplasia of the tumor cells. Mallory stain reveals only a very fine reticulum in the tumor mass. Phosphotungstic acid hematoxylin stain shows no myofibrils. There is very little difference between this specimen and the biopsy specimen taken before radiation therapy. Pathological diagnosis: leiomyosarcoma.

Summary. A 25-year-old man had been treated under the diagnosis of pernicious anemia, but x-ray examination revealed large tumor masses of the stomach. Although malignant growth was considered, the diagnosis of polyposis was made. The same diagnosis was made at gastroscopy, although retrospectively it must be admitted that the picture



Fig. 5. Photomicrograph, Case 1. Survey section through rather normal gastric mucosa and adjacent tumor.

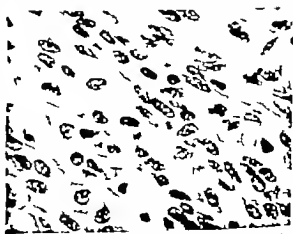


Fig. 4. Photomicrograph, Case 1. High power. Irregular sarcomatous tissue. Some typical smooth muscle cells.



Fig 5 Case 2 a, left, Roentgenogram taken before gastroscopy with complete filling, no pathology demonstrable b, After gastroscopy—relief method. Shallow filling of lesser curvature with niche formation. Two fistulas extend into the depth of the tumor.

described in the gastroscopic protocol ("never seen before—") was not consistent with the diagnosis of polyposis; the possibility of malignant tumor was considered. A biopsy specimen taken at an exploratory laparotomy revealed leiomyosarcoma. X-ray treatment was not effective. At a second laparotomy total gastrectomy with splenectomy and partial pancreatectomy was carried out. The patient recovered.

CASE 2 A S 56 year old white male No. 864521 entered Los Angeles County Hospital on December 21, 1943, with the history of melena which had occurred 24 hours before. In the afternoon of that day he suddenly felt sick, nauseated and vomited a cupful of dark blood. For 10 years he had vague abdominal distress occurring hours after meals and relieved by food. There had been no recent weight loss.

Physical examination revealed a well developed, well nourished male. Slight pallor of the visible mucous membranes was present. There was mild epigastric tenderness but no mass was felt. The hemoglobin was 56 per cent. Occult blood was found in the feces.

On January 26, 1944, the patient, after bed rest, dietary treatment and transfusions, had recovered so much that x-ray examination seemed permissible.

First x-ray examination. The upper gastrointestinal series did not show anything abnormal (Fig. 5a) except spasticity of the duodenal bulb consistent with early shallow ulcer. This diagnosis seemed clinically acceptable and the patient was in such a good condition that his discharge was planned. He

was seen by one of us in consultation, however, and advice for gastroscopy was given in order to determine if possible the true origin of the bleeding.

Gastroscopy was done on February 11, 1944, by Dr. David Niemitz and one of us (R. S.) (Fig. 6).

The instrument encountered resistance at first at the cardia, which was suddenly overcome and the instrument went into the depth of the stomach. The angulus and pylorus were in the two o'clock position and a picture was even obtained in the three o'clock position. There was some dullness and formation of nodules in the lower anterior wall. As the instrument was withdrawn a hemispherical tumor entered the visual field at the six o'clock position (see Fig. 6). It was covered with smooth, very pale mucosa. No ulcer or necrosis was seen. Higher up the tumor was so close to the instrument that no detail could be made out. The tumor extended up to the cardia, was 8 centimeters in length. Impression: (1) tumor of greater curvature and posterior wall below the cardia. *Carcinoma is most likely, however, a benign tumor, especially myoma, may be present.* (2) distortion of the lower portion of the stomach. (3) mild hypertrophic gastritis of the lower portion of the stomach.

Because of the tumor seen a repeat x-ray examination was suggested.

Second x-ray. At this second examination, February 16, 1944, care was taken to examine the relief of the mucosa and the patient received only one swallow of barium (Fig. 5b). Two niche-like protrusions are seen on the posteromedial side of the stomach at the junction of the proximal and middle

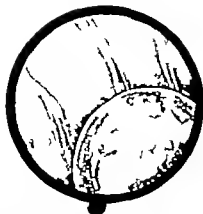


Fig. 6 Gastroscopic picture. Case I the upper third of the stomach a round mass tumor was seen protruding from the greater curvature and posterior wall.

third. These measure 2 centimeters in length and probably represent a perforation which in view of the gastroscopic findings could be into a neoplasm. The rugal pattern of the stomach is essentially normal (except in the area of the niches) but the cardiac end of the stomach appears to be displaced laterally and anteriorly by a soft mass. The findings are consistent with a perforated gastric ulcer with an adjacent inflammatory mass or—less likely—perforation into a carcinoma.

As the gastroscopic diagnosis of a tumor seemed perfectly reliable surgery was advised.

Operation was performed by Dr. H. Schiffbau on February 24, 1944. A large tumor mass of the posterior wall was found. Total gastric resection proved feasible. The spleen was removed. The tumor was found to be firmly adherent to the tail of the pancreas so that resection of the tail of the pancreas became necessary. No metastases were found.

The patient survived the operation a week later was in excellent condition, and made an uneventful recovery. He reported on September 30, 1944, that he felt fine. There was no recurrence of bleeding or any gastrointestinal distress.

Gross pathology. The gross specimen is pictured in Figures 7 and 8. Figure 7 shows the resected spleen, tail of pancreas and the posterior wall of the stomach containing an irregularly round tumor with node formation measuring 15 by 10 by 6.5 centimeters. In Figure 8 the upper half of the stomach has been opened across the anterior wall. In the posterior wall toward the lesser curvature there is an irregular ulcer 5 by 6 millimeters in size. Obviously this ulcer corresponds with the niche formation observed at the second x-ray examination (Fig. 5b) and it was missed gastroscopically because of its location in the well known "blind area" of the posterior wall (16). Close to its lateral margin a smooth rounded protrusion can be seen. It is caused by a node of the tumor and was seen and diagnosed at the gastroscopic examination. In the picture of the gross specimen there are bridging folds at the



Fig. 7 Gross specimen. Case I. Posterior surface. At left is the spleen, at right the expansively growing leiomyosarcoma of the upper portion of the stomach, beneath it (crossing the stomach) the tail of the pancreas.

lower pole of the tumor. Unfortunately at gastroscopy the tumor bulged so much that the lower recess with these typical folds was not seen. The large tumor is found at the left side of the picture. It extended into the gastrocolic omentum and into the pancreas.

Microscopically the typical picture of leiomyosarcoma is seen (Fig. 9). At some places rather regular smooth muscle cells are found. But in other places the cells are irregular only few nuclei still have the characteristic regular elongation with rounded edges of the normal nucleus of the smooth muscle cell. Most of them are oval or round, of various sizes and mitoses are observed. Most portions of the gastric mucosa (except that of the ulcer area) of the muscularis mucosae and even of the submucosa covering the tumor are perfectly normal.

Summary. A large leiomyosarcoma was found in a 56 year old male which probably had developed over a period of about ten years and had caused only mild epigastric distress. Acute hemorrhage led to hospitalization. At the first x-ray examination the tumor was overlooked because no relief technique was used. Gastroscopy revealed the presence of the tumor but the picture as seen was not exactly that of a carcinoma because the surface looked unusually smooth however it did not correspond with that of a benign myoma because the tumor extended diffusely toward the cardia. A second x-ray examination with relief technique revealed an ulcer niche. At surgery a leiomyosarcoma was found growing



Fig. 8. Gross specimen. Case 3. Anterior view. Upper two-thirds of stomach opened across the anterior wall. At the left side the huge tumor at right upper corner the spleen. The inside of the stomach shows the ulcer demonstrated by x-ray on Figure 5a, and the tumor protrusion seen at gastroscopy (Fig. 6)

expansively into the omentum and pancreas. Total gastrectomy with extirpation of the spleen and the tail of the pancreas led to cure which because of the good limitation of the tumor and the absence of metastasis may be permanent.

CASE 3 W B a 60 year old white male No. 104075 entered the White Memorial Hospital Los Angeles on July 11 1943 complaining of increasing weakness for 1 year. For 8 months he had suffered from distress in the left epigastrium occurring 4 hours after meals and which was promptly relieved by eating. About 2 months prior to entry he became dyspneic on mild exertion and noticed numbness and tingling in his extremities. Physical examination revealed marked pallor of the mucous membranes. The liver edge was felt just below the costal margin. No abdominal mass was felt and there was no tenderness. Hemoglobin was 6.3 grams red blood cells 900,000 color index 1.0 leucocytes 3,900 reticulocytes 0.5 per cent. Gastric analysis failed to reveal any free hydrochloric acid with the histamine test.

A tentative diagnosis of pernicious anemia was made. Treatment with parenteral liver extract was begun and 6 days later the reticulocytes rose to 22 per cent. After 8 days the hemoglobin rose to 8.8

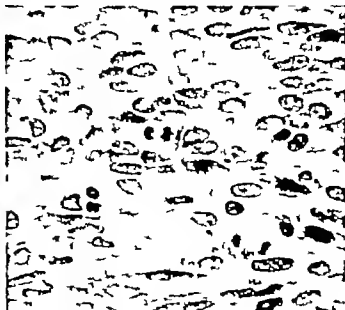


Fig. 9. High power photomicrograph, Case 3. Irregularly formed sarcomatous cells. Mitoses.

grams red blood cells 1,960,000 and leucocytes 8,500.

The first x ray examination of the stomach was done on July 15 1943 (Dr. Stilson) with the following report: The stomach is of average tone. The major portion of its lumen is regular and flexible. The cardiac end of the stomach however on the film appeared rather peculiar and it is evident that the stomach empties rapidly. Probable neoplasm of the cardiac end of the stomach.

The second x ray examination was carried out by Dr. W. L. Stilson on July 19 1944 after the first gastroscopy. The report read: Now there are demonstrated definitely fluoroscopically and on the films extensive filling defects involving the proximal portion of the stomach, except the extreme cardia and extending for a distance of approximately 9 centimeters. The lesion apparently arises about 3 centimeters distal to the cardia.

The x ray pictures are partly rendered in Figures 10 and 11. In Figure 10 only the colon is filled with contrast meal but the stomach is empty. Here a tumor can be seen very well as a shadow within the air bubble of the stomach. Figure 11 demonstrates the large filling defect in the barium filled stomach. One should notice that no central crater is definitely visible though the barium accumulation at the lesser curvature side of the tumor may be interpreted thus.

Two gastroscopic examinations were carried out.

First gastroscopy (O.A.B.) on July 18 1944. The pyloric end of the stomach was well seen and several peristaltic waves could be seen running down to the pylorus the entire circumference of which came into view. Just above the angle along the lesser curvature there were 2 or 3 rather prominent folds which seemed to be somewhat redder than the surrounding mucosa which was extremely pale. About 5 or 6



Fig. 3. Case 3. Fundus of the colon is filled. The stomach is empty. The tumor is outlined toward the dark background of the gastric air bubble.

centimeters above the angulus on the anterior wall, extending down to the greater curvature a well defined mass could be seen. This mass was very red and succulent in appearance in contrast with the extremely pale surrounding mucosa, and there seemed to be several finger like processes. When the instrument was withdrawn the large red mass came in contact with the objective and it was impossible to see its uppermost portions. Along the posterior wall and greater curvature in the lower part of depth II, blood could be seen lying between the rugal folds but no point of active hemorrhage could be seen. In all portions of the stomach which were observed the mucosa was extremely pale almost to the point of whiteness.

Impression (1) carcinoma of the stomach involving the anterior wall and greater curvature of the upper and midportions of the stomach. (It was impossible to visualize the margins of this tumor mass and hence I cannot be certain that it does not extend all the way up to the cardia) (2) no gastritis seen."

Second gastroscopy (O.A.B. and R.S.) on July 30 1943. Immediately with the objective turned to nine o'clock extensive pathological changes were seen. A stiff protruding area bulged into the cavity of the stomach from its anterior wall involving the greater curvature also. At its deepest point there was a dark red protuberance and to both sides of this protuberance was a less dark wall surrounding the stiff area. This wall hung over in a mushroom-like fashion and pale pink, soft normal mucosa was submerged beneath the margins of the mushroom-like wall. On the top of the stiff elevation there was extensive white necrosis or ulceration. When the instrument was withdrawn the infiltrated area came



Fig. 4. Case 3. Stomach filled. Trudekburg position. Large filling defect.

close to the objective. The wall, however could be followed all around the lesion. It became much thinner in the upper portions of the stomach but remained sharply limited from the surrounding pale mucosa which its dark color formed a decided contrast. In the pale mucosa no sign of atrophy, no thinning, and no blood vessels were seen. Toward the upper edge of the wall several mucosal folds emerged as if they were running up the wall in a manner usually only seen in a benign ulcer (see Fig. 12). There was no infiltration. The upper limit of the wall was found to be 6 centimeters below the cardia. Impression (1) large carcinoma of the anterior wall and greater curvature of the body of the stomach (This is most likely a Type II carcinoma according to the classification of Borrmann. These Type II carcinomas usually give an excellent surgical prognosis) (2) No gastritis visible.

On July 3 1944, a gastric resection with anterior pyloric anastomosis was performed leaving only a small amount of the subcardial portion of the stomach (Dr. George Thomason). The patient recovered. The gross specimen contained a pedunculated tumor of the cardiac end of the stomach. This pedunculation is not well demonstrated in the picture of the gross specimen (Fig. 13) which demonstrates more the gross appearance. The tumor was 6 centimeters in diameter. Its surface was rough, irregular and contained three large ulcerated areas. A Type II Borrmann carcinoma was diagnosed at gross inspection.

Microscopically the tumor consists of smooth muscle tissue. The cells are partly regular and well



Fig. 12. Gastroscope picture. Case 3. At the left lower margin the fold of the cardia is seen. It is separated by normal mucosa from the upper edge of a tumor. The protruding tumor has a nodular wall and contains a large ulceration. Note especially the one 'bridging fold' running from the normal mucosa up to the tumor wall because of its diagnostic significance.



Fig. 13. Gross specimen. Case 3. At the right side of the large tumor there is extensive ulceration. The pedunculation does not show.

differentiated, partly irregular in form and without complete differentiation (Fig. 14). Scattered between the solid tumor masses are nests of plasma cells and macrophages. Where the tumor pierces the mucosa there is no sharp capsule. The neighboring mucosa shows some cysts at the bottom of the glands.

The mucosa of the anterior wall and lesser curvature distant from the tumor shows mild but definite changes. The interstitium between the long body glands contains few cells, mostly plasma cells and fibroblasts. The muscularis mucosae itself is split up. Between the muscle fibers are inflammatory cells. Most of the body glands are normal but some pits are proliferating toward the depth and at a few places metaplasia into an intestinal type of epithelium is seen. The surface epithelium shows mild but definite proliferation and between the pits there is some slight edema. Thus there is a mild but definite atrophic gastritis present. (It may be said here that this picture in our opinion is compatible with the diagnosis of pernicious anemia. It is of interest, furthermore, that this mild degree of atrophic gastritis was not recognized at two gastroscopies.)

Six months later the patient complained of swelling of the legs and of anorexia, but under continued liver treatment the distress disappeared. The blood picture remained normal. However, the patient was constantly treated with liver injections.

A third gastroscopy was undertaken on July 23, 1944 (O.A.B.). The gastroscope entered the jejunum; no tumor was seen. The gastric mucosa looked pretty normal but toward the cardia there was some thinning with blood vessels—atrophy of gastritis—not seen at the previous gastroscopies.

The patient was last seen in March 1945 at which time he felt quite well. Repeated x-ray examinations have failed to reveal any recurrence of the tumor. There was immediate emptying of the stomach stump.



Fig. 14. Photomicrograph. Case 3. The gastric mucosa contains cysts and 'cock-screw' glands—first signs of atrophy. The myomatous tumor at its break through the stomach wall has no capsule.



Fig. 5. Case 4. Roentgenogram interpreted as normal. However! the fornix contour and fleck are seen which may be interpreted as the outline and central ulcer of the tumor

resected specimen this tumor was found to be a pedunculated one but only at microscopic examination was the diagnosis of leiomyosarcoma made. Retrospectively it must be admitted that the second gastroscopic examination (Fig. 12) had revealed a feature which should have been considered as almost incompatible with the picture of gastric carcinoma, namely the presence of a bridging fold as described previously (19) as characteristic of submucosal tumor. The very large ulceration and the high dark red wall surrounding the ulceration reminded one so much of the frequently observed pictures of gastric carcinoma that the importance of this one fold for the correct diagnosis was underestimated although the gastroscopic protocol stated the presence of such a bridging fold "usually only seen in submucosal tumors".

The tumor was removed by extensive resection and the patient is living now in satisfactory condition. Of special interest is the blood picture obtained in this case. It will be discussed later.

CASE 4. E. T. a 46 year old Ethiopian female entered the Los Angeles County Hospital on January 16, 1941. One year before admission she had had hematemesis followed by occasional passage of black stools. She noticed increasing constipation and a weight loss of 60 pounds. Three weeks before

entry she became weaker and dyspneic. Repeated melena was observed. Twelve days before admission she vomited one pint of dark blood. She had had only a little epigastric distress.

Physical examination revealed an obese colored woman, with pallor of mucous membranes, rales at the base of the left lung and a systolic murmur over the mitral valve. On palpation of the abdomen no masses were felt. Gastric analysis revealed 85 units of free hydrochloric acid after histamine.

X-ray examination, February 20, 1941 revealed the following: Esophagus and stomach did not reveal any abnormalities. There was a normal 6 hour progress. The duodenal bulb was smooth. The hemoglobin which was 15 per cent on entry was brought up to 70 per cent after numerous transfusions. On March 10, 1941 the patient was discharged with the diagnosis of gastrointestinal hemorrhage of unknown etiology.

She re-entered the hospital on June 28, 1941 because of melena. The hemoglobin was down to 18 per cent. On July 14, 1941 x-ray examination was again undertaken. Normal six hour progress. Esophagus and stomach essentially negative. The duodenal bulb is small, but showed smooth outlines fluoroscopically. No tenderness, irritability or spasticity.

Gastroscopy (H.L.T.) was carried out July 3, 1941 and the report follows: Pyloric end of stomach normal in color and configuration except that there were multiple small pigmented hemorrhagic areas. In the proximal portion of the body there was a large necrotic ulcer with a fungating hyperplastic edematous margin typical of carcinoma. The high position and large size of the lesion makes its operability questionable. In view of the otherwise good general condition of the patient, surgical exploration is probably advisable.

X-ray films were taken again on July 25, 1941. Then a constant filling defect of the cardiac end of the stomach on the greater curvature side consistent with a polypoid neoplasm probably carcinoma was found. (If however Figure 16 of this x-ray examination is studied the conclusion may be drawn that there is a tumor of the cardiac end of the stomach with a central ulcer. The significance of this picture will be discussed later.)

On July 31, 1941 total gastrectomy with splenectomy and partial pancreatectomy was carried out (Dr. Harlan Shoemaker). The patient died post-operatively on August 5, 1941 from massive pulmonary atelectasis.

The gross specimen consisted of the excised stomach which contained in the upper posterior wall a cartilaginous-looking mass measuring 5 by 11 by 4.5 centimeters with a large mucosal ulcer of its central portion. The tumor had grown expansively beneath the mucosa and extended to the serosa forming there a knobby projection.

Microscopically there are intertwining bands of elongated spindle-shaped cells. Few mitotic figures are seen. The regional lymph nodes do not contain

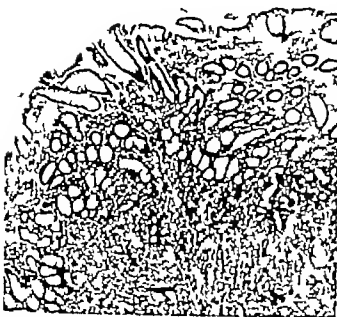


Fig. 16. Case 4. The diffusely infiltrative leiomyosarcoma has grown destructively into the gastric mucosa. Signs of atrophy.

any tumor cells. Figure 17 shows that the tumor invades and destroys the mucosa which contains only remnants of glands. Some of these may still be seen within the tumor tissue. Some show cystic dilatation.

An autopsy was performed by Dr L. K. Andersen. Massive atelectasis of the lungs was found. In the liver there was a firm nodule 2 centimeters in diameter on the posterior surface of the left lobe. Macroscopically it proved to be a leiomyosarcoma metastasis (Fig. 17) without capsule.

Summary. A 46 year old woman had had severe attacks of hematemesis and melena for over a year. The source of the bleeding was not found after the first admission and would have been overlooked at the second admission without gastroscopy. With this method an ulcerated tumor of the upper portion of the stomach was seen and interpreted as a carcinoma. Surgery revealed an intramural leiomyosarcoma. Total gastrectomy with splenectomy and partial pancreatectomy was performed. The patient died from massive pulmonary atelectasis. On autopsy one small metastatic node in the liver was found.

DISCUSSION

A brief discussion of the x ray diagnosis, gastroscopic diagnosis, relationship to pernicious anemia, and therapy of leiomyosarcoma of the stomach follows.

X ray diagnosis. In our material the diagnosis of a gastric tumor was missed at one x ray examination in Case 2 and at two x ray examinations in Case 4. In these 2 cases the



Fig. 17. Case 4. Photomicrograph showing liver metastasis. At left liver tissue. At right leiomyosarcoma tissue without capsule.

presence of a gastric tumor was found at gastroscopy. This rather poor result can obviously be improved. In both cases the tumor could be demonstrated at a repeat x ray examination when the proper technique was used. These 2 cases prove again the fact that the method of filling the stomach completely with barium suspension and then taking films is unsatisfactory. It must be replaced routinely by the relief method (22). With this method the relief of the stomach is studied and much finer lesions than those found in Cases 2 and 4 will not be overlooked.

The diagnosis of benign submucosal tumor at x ray examination can be dared if a sharply defined round filling defect with a central niche is noted. The central niche is characteristic of the central ulceration so frequently found in these tumors. However in leiomyosarcoma it may be more difficult to state that this tumor originates from beneath the mucosa, i. e. from the submucosa or muscularis propria. A case report published by Chaffin however shows how astonishingly correct diagnoses become possible if proper technique and deliberate interpretation are used. The x ray examination in that case was carried out by Dr D. R. Laing of Pasadena and the x ray protocol (May 28, 1936) read:

"The stomach is somewhat hypertonic. Near the junction of the distal and middle thirds of the stomach is an area approximately 5.5 centimeters in diameter which is not covered with barium except for an area 2 centimeters in diameter in its approximate center. There a few radiating lines extend from this center pocket of barium to the proliferation

of the rounded lesion. The stomach was very pliable. Peristaltic waves moved over very freely and were only lessened in this region to the extent that the lesion impinged on the respective curvatures. The rugal pattern was intact except in the area occupied by the lesion. The center of the lesion could be emptied of its barium by palpation. There was no tenderness in this lesion. The duodenal bulb filled readily and smoothly. The findings are suggestive of a solitary mass with central necrosis which may be due to sarcomatous degeneration. The possibilities of localized hypertrophic gastric mucosa or a large polyp with central ulceration or umbilication must also be considered.

Here proper interpretation had led to the correct diagnosis of a submucosal tumor. The central ulceration seen was interpreted in favor of sarcomatous degeneration. This is not correct. Perfectly benign submucosal tumors of every kind, even lipomas, may have similar central ulceration. In this case however definite leiomyosarcoma was found microscopically and the fact remains that the roentgenologist had stated correctly that a malignant tumor of the stomach had originated from the submucosal layers.

If we review critically the x ray protocols of our 4 cases, then we may say that in Case 1 probably the correct diagnosis of a tumor originating submucosally was impossible. Large neoplastic masses were seen, they appeared benign but malignant growth could not be excluded. However at the examination of the excised gross specimen an ulcer was found and the floor of this ulcer penetrated for at least 1.5 centimeters into the tumor mass. This indicates a kind of fistula formation. Such a fistula might have been seen at x ray examination. In carcinoma this feature is observed rarely if ever.

Case 2 shows that this sign may be demonstrated at the x ray examination of leiomyosarcoma. At the second x ray examination the picture rendered in Figure 5b was obtained. A shallow filling defect is seen with an ulcer niche formation. Two fistulas extend into the depth. Each of these fistulas has a length of 2 centimeters. They were described well in the x ray protocol. In consideration of a similar picture in the gross specimen of Case 1 we conclude that filling defect with central niche and fistulas at x ray examination is rather characteristic of leiomyosarcoma.

In Case 3 the tumor was at first seen best as a round shadow within the gastric air bubble. Later a round filling defect within the barium was seen. The diagnosis of submucosal tumor was impossible at x ray examination because the tumor protruded into the mucosa and was pedunculated. We do not believe that at x ray examination the differentiation from carcinoma in this form of leiomyosarcoma is possible.

In Case 4 two x ray examinations had failed to reveal the tumor. After gastroscopy at a third x ray examination. Polypoid neoplasm, probably carcinoma was found. But if we look at this picture (Fig. 15) then we see a central niche within a tumor of the fornix and this central small crater may have suggested perhaps presence of a submucosal tumor.

Thus we come to the conclusion that in 3 of our 4 cases the x ray diagnosis of a submucosal tumor would not have been entirely impossible. It must be admitted that in some cases (as in our Case 3) the differentiation from carcinoma at x ray is impossible but the x ray syndrome of filling defect plus central niche plus fistulas should be considered as highly suggestive of leiomyosarcoma.

Gastroscopic diagnosis. In none of the 4 cases was the correct diagnosis made at gastroscopy but in 2 of the cases (Cases 2 and 3) features were described in the gastroscopic protocols which had a certain relationship to submucosal tumors, and this relationship had been stated.

If we analyze the gastroscopic pictures of the 4 cases, we find that in Case 1 the gastroscopic protocol offers no foundation for the final diagnosis of 'polypoid'. The gastroscopic findings correspond with every feature later found in the gross specimen. This gross specimen has no similarity to the well known picture of gastric polyps. The protocol states that in the antrum a soft, protruding mass was seen. Other large hemispherical protrusions were described which sloped gently toward the gastric wall. The elevation of other small protrusions was 'partly so that a shadow was cast on the surrounding mucosa but in other portions of the circumference there was a gradual sloping. This description does not

fit with any picture of carcinoma neither does it correspond with the known pictures of lymphosarcoma. It certainly should not have been interpreted as polyposis. We believe that the appearance of the antrum alone would have permitted the diagnosis of a sarcoma.

In Case 2 the correct diagnosis of a tumor was made. It was then stated that Carcinoma is most likely however a benign tumor especially myoma may be present. The latter tumor was considered because of the smoothness and roundness of the tumor seen. The consideration of carcinoma and of myoma came pretty close to the truth and one cannot consider this diagnosis as entirely wrong. The gross specimen showed bridging folds at the lower pole of the protrusion but these folds the observation of which should have established the diagnosis of a submucosal tumor were not seen at gastroscopy. It seems that these folds usually are numerous and present at all sides of a benign submucosal tumor but they are only occasionally seen if the submucosal tumor starts to grow expansively and infiltratively.

Only one such fold was noticed in Case 3 (Fig. 12). Its presence should have forced the observer into the correct diagnosis in spite of his unwillingness to assume another case of leiomyosarcoma. We quote here the decisive sentence of the protocol in order to show how reliable such apparently minor gastroscopic signs are: toward the upper edge of the wall several mucosal folds converged one of them running up to the wall in a manner usually seen only in submucosal tumors.

In Case 4 the gastroscopic appearance was that of a carcinoma, and retrospective analysis reveals no sign which could have been interpreted as characteristic for a submucosal tumor.

Thus we come to the conclusion that in 3 cases (1, 2 and 4) the x-ray diagnosis would not have been impossible and that in 3 cases (1, 2 and 3) the correct gastroscopic diagnosis should have been made. The preoperative diagnosis of leiomyosarcoma of the stomach is in the realm of possibility.

Relationship between leiomyosarcoma and pernicious anemia. The frequency of benign adenomas in pernicious anemia is well known

(Brown Schindler, 17). More and more the opinion gains ground that carcinoma develops secondarily to pernicious anemia more frequently than should be expected. However no such relationship is known between pernicious anemia and tumors of muscular tissue.

In our material twice a pernicious anemia was diagnosed (Cases 1 and 3). This diagnosis was obviously wrong in Case 1 in which free hydrochloric acid was found at the histamine test. In Case 3 the clinical picture was that of pernicious anemia. The hemoglobin was 63 grams with a red count of only 900 000. The color index was 2.0. The white count was 3 900. There was 0.5 per cent of reticulocytes. After liver therapy there was a typical response: the reticulocyte count went up to 22 per cent. There was no free hydrochloric acid in the gastric contents at histamine test. The gastric mucosa did not show any sign of inflammation at gastroscopy but by microscopic examination mild but definite atrophic gastritis was found. Schindler and Serby (20) described cases of untreated pernicious anemia in which only partial atrophic gastritis was seen and one case in which no atrophy at all was seen but only superficial gastritis. The conclusion must be drawn that pernicious anemia is not necessarily accompanied by severe or complete atrophy but that mild inflammation may be present as well. In this Case 3 everything speaks in favor of pernicious anemia being present.

Relationship between pernicious anemia and the gastric muscularis propria is known to exist. Koch described 3 cases of hypertrophy of the pyloric musculature in pernicious anemia. Mayeda described enormous thickening of the muscularis propria increasing from the cardia to the pylorus in a case of pernicious anemia. It is true that in cases of malignant tumor of the stomach macrocytic anemia has been observed but in all such cases the question remains open whether or not the macrocytic anemia preceded the tumor formation. Although we cannot exclude the possibility of a macrocytic anemia caused by the leiomyosarcoma of our Case 3 we want to suggest the possibility of the reverse sequence: namely pernicious anemia leading to formation of leiomyosarcoma.

Treatment The gross and microscopic observation in Case 1 shows that x ray treatment of gastric leiomyosarcoma is ineffective.

Surgery however proved to be eminently satisfactory. In one case (Case 3) extensive gastric resection was carried out. In the 3 other cases total gastrectomy with splenectomy and pancreatectomy was performed. Only one patient died postoperatively (Case 4) and this death was not due to abdominal catastrophe but to massive pulmonary atelectasis. Three patients survived the enormous procedure and seemed to be cured permanently. It is remarkable that these operations were performed by four different surgeons in three different institutions. Certainly surgery was in extraordinarily competent hands in all cases and there is no doubt that great progress has been made with the technique of such procedures as total gastrectomy and partial gastrectomy. Yet one may consider the possibilities that the vitality of patients with leiomyosarcoma may not be so affected as it is usually in carcinoma. In leiomyosarcoma the surgeon cannot be easily too courageous. The excellent results obtained in our series justify the attempt to remove even the largest tumors.

SUMMARY

1. Four cases of leiomyosarcoma have been described.

2. The possibilities of the roentgeologic and gastroscopic diagnosis of this tumor have

been discussed. Its possible relationship to pernicious anemia has been considered and the excellent results of surgical treatment have been described.

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COMPOSITE FREE GRAFTS OF SKIN AND CARTILAGE FROM THE EAR

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BRADFORD CANNON M D Lieutenant Colonel MC. A.U.S., Boston, Massachusetts

FREE grafts consisting of two surfaces of skin with cartilage between can be considered for the replacement of tissue lost from areas such as the nostril border and tip and columella. These defects can be corrected in one procedure with the best resulting appearance of any method used.

This work has been done at Valley Forge General Hospital in association with Major Carl E. Lischer, Major Parke Scarborough, Captain Bowdoin Davis, Captain Andrew Moore, and Captain Joseph Murray.

there is minimal deformity of the donor site and the use of bulk flaps is avoided. The ear can be repaired with a local flap or by burying the open ear under a direct scalp flap from behind and freeing it and grafting the defect 2 to 3 weeks later.

The procedure is useful for tissue losses from burns, gunshot and shell fragment wounds as well as other traumatic or operative losses. It is necessary that there be a

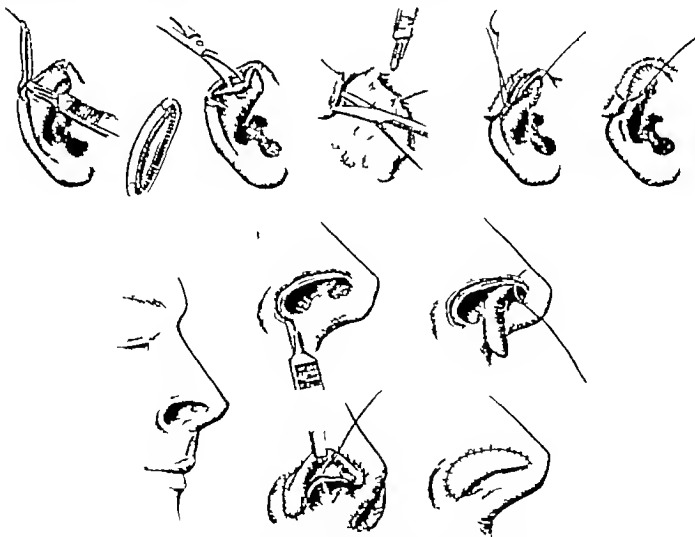


Fig. 1. Illustrating the steps in repair of nostril border with composite free grafts of skin and cartilage. Drawing by T/S David G. Parsons.

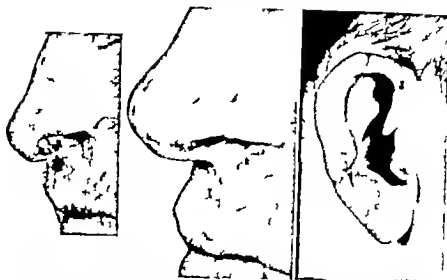


Fig. 4. Complete restoration of ala in single operation. With composite free graft of skin and cartilage. Ear border already deformed by being shot through, used for ala before repair of ear with direct scalp flap. Flap detached 3 weeks later.



Fig. 5. Restoration of columella, tip, and ala in single operation by use of composite free graft of skin and cartilage. Notching of upper and lower lips has been corrected.

satisfactory minute blood supply in the recipient area and the defect has to be opened widely and deeply over a sufficient area. This procedure creates a larger defect to be filled than the original defect.

The size of replacement tissue of course is limited. So far the whole columella, tip and one border of the nose have been put in at one operation, also nostril borders on two sides.

A great bulk of tissue cannot be transplanted as a free graft; the maximum at present has been about 1 centimeter in width, length has not been important. The amount of available ear structure is also a determining factor; the part of the border containing cartilage being used. (In some instances, the ear border is already deformed and has to be repaired anyway so that no extra operation is

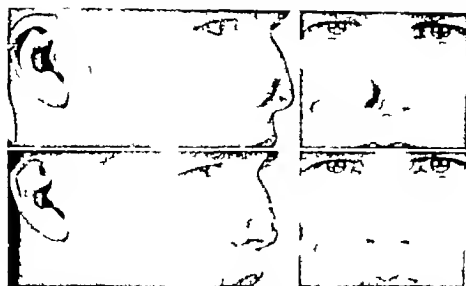


Fig. 4. Large replacement of nostril defect by use of free composite graft of skin and cartilage in a single operation. Minimal ear deformity with scalp flap restoration.

necessary. The desired graft is taken off for the nostril when the ear is repaired. In severe burns when both ears are largely destroyed the source is lost.) At operation the defect is prepared so that the area has a good minute blood supply. The graft is cut to pattern from a suitable portion of the ear in a region where cartilage presents just under the skin. Care is taken not to separate skin from cartilage. The crus of the helix can be utilized.

The graft is sewed accurately in place with fine sutures along all edges with one or two deep ones at the start.

The nostril is packed and a firm pressure dressing applied. The graft may become blue and discolored and even blister and careful attention and protection are required in its management.

Small areas of flat cartilage with overlying skin can also probably be done but enough observations have not been made to report this variation. This graft is taken from behind the ear and the skin is cut larger than the cartilage so that it can spread out and pick up a blood supply. These grafts necessarily have to be small and the skin over the cartilage probably survives because of a lateral blood supply coming in through the edges rather than by a supply through the cartilage.

SUMMARY

Sections of the border of the ear containing two surfaces of skin with cartilage in between have been successfully transplanted as free grafts and defects of the nostril border tip and columella have been repaired satisfactorily in a single operation.

SUBCUTANEOUS HEPARIN IN THE PITKIN MENSTRUUM FOR THE TREATMENT OF EXPERIMENTAL HUMAN FROSTBITE

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WHILE numerous reports¹ have been published concerning the morphologic changes that occur in frostbite the literature concerning the functional pathology is scarce. Green's excellent studies of the pathologic changes occurring in experimental frostbite pointed the way for detailed investigation of the physiologic changes occurring in this lesion. The use of the fluorescein test (3, 4) was a medium through which the sequence of events could be observed in tissues exposed to severe cold. In this test small amounts of fluorescein are injected intravenously and the migration of the dye through the blood stream and the interstitial spaces is observed under long wave ultraviolet light.

As a result of studies in artificially frost bitten animals (5) it was established that for periods from 30 to 120 minutes following exposure to severe cold no fluorescein appears in the exposed areas thus indicating a severe spasm of the arterioles. This condition is followed by a second stage during which all blood vessels reopen and fluorescein can be seen throughout the exposed areas. The diffusion of the dye into the surrounding tissues in this stage is many times greater than it is in the nonexposed skin due to increased capillary permeability; the picture of intense hyperfluorescence in the previously frozen areas is thus produced. This period is also characterized by marked swelling of the exposed region. Eight to 14 hours after exposure a repeat fluorescein injection shows that now the exposed spots are nonfluorescent indicat-

ing a pregangrenous state. This nonfluorescence increases in the next hours until finally the entire focus is nonfluorescent and becomes gangrenous. Biopsy specimens taken at this time show that in agreement with the findings of Green and Kreyberg there is a clumping of red cells in the dilated smaller vessels. This clumping is probably due to loss of plasma through the highly permeable vascular wall. The red cells are stranded and fill the blood vessels, thus forming a sludge. They do not, however, represent *true* thrombi. The simple injection of saline enables one to wash out these erythrocytes as individual cells. Only after at least 72 hours does organization of these cells occur. This organization ultimately leads to infarctive gangrene. It is during the prethrombotic sludge phase that the therapeutic attack must be initiated to avoid thrombosis and ultimate infarctive gangrene as promptly as possible following exposure and ideally before thawing is complete.

Animal experimentation substantiated the fact that the timely use of heparin prevented gangrene whereas control untreated animals uniformly developed gangrene commensurate with the degree of frostbite.

It was now essential to apply these experiences to the human. The practical demonstration of the therapeutic value of heparinization in the prevention of gangrene was made possible by the study of artificial frostbite in human volunteers. These volunteers were recruited from patients who were being treated for subacute bacterial endocarditis by the combination of penicillin and heparin (6).

This investigation in human volunteers had a twofold purpose: first to corroborate animal experiments and second to evolve a simple practical method for the heparin treatment of frostbite. The subcutaneous heparin prepara-

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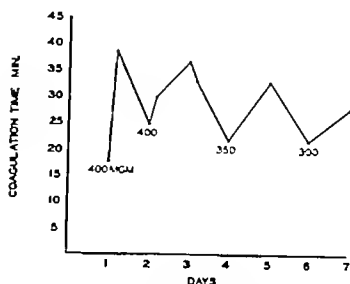
Aided by grant of funds from friends of the Jewish Hospital and the John and Mary R. Marble Foundation and the Council on Pharmacy and Therapeutics of the American Medical Association.

TABLE I

HEPARIN—PITKIN MENSTRUUM FORMULAE

With vasoconstrictors	LP-0 mgm.	LP 8 mgm.	LP 16 mgm.	LP mgm.
Crystalline sodium salt of heparin	00	200	00	
Epinephrine hydrochloride	.0			
Epinephrine sulfate	5	5	5	
Chlorbutanol	5	5	5	
Eucalypt dihydrochloride	.0			
Pitkin menstruum q. ad.	oc. c.	oc.	oc.	oc.
Without vasoconstrictors	LP 4 mgm.	LP 8 mgm.	LP 16 mgm.	LP mgm.
Crystalline sodium salt of heparin	00	200	00	
Chlorbutanol	5	5	5	
Eucalypt dihydrochloride	.0			
Pitkin menstruum q. ad.	oc. c.	oc.	oc.	

SZ



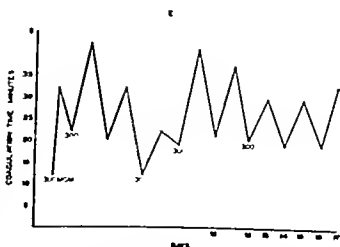
Graph 1 Coagulation time in Case 2 SZ.

tion in the Pitkin menstruum (7-9) seemed uniquely applicable in this connection. The intravenous administration of the aqueous commercial preparation of heparin would involve a more elaborate set up than the simple intramuscular or subcutaneous injection of the drug in Pitkin's menstruum. This method of depositing heparin achieves a consistent retarded, and equal release of the anticoagulant. The Pitkin menstruum which was designed to regulate the rate of release of water soluble drugs is composed of gelatine, dextrose, glacial acetic acid, and water in definite proportions.

Various formulae (Table I) have been developed containing variable amounts of heparin in the Pitkin menstruum with or without vasoconstrictors. The vasoconstrictors have an additive prolonging effect. By combining the injection of various ampuls, one is able to employ greater or lesser amounts of heparin with or without vasoconstrictors.

The method of administration is as follows: the contents of the ampuls are liquefied in hot tap water drawn up through a 2 to 5 inch 18 gauge needle into a 5 or 10 cubic centimeter syringe and injected subcutaneously, preferably into the anterior or lateral aspect of the thigh. The pain and discomfort is variable and transitory. The injections are given, as a rule, every day or every other day, and the average dose is 300 milligrams of heparin. Occasionally, 400 milligrams is required. The correct dosage is estimated by following the coagulation

time as determined by the Lee-White modification of H. Wells's method. By this method the average normal coagulogram is 9 to 15 minutes. Prolongation to 30 minutes to an hour is considered a satisfactory response. The response to the preparation is predictable in most instances as judged by observation of its clinical department in considerably over 1000 depositions administered in well over 200 patients suffering from subacute bacterial endocarditis or thromboembolic disease. The anticoagulant effect may be markedly depressed by the application of ice bags to the site of the deposit or may be accelerated by the local application of heat. Because of the urgency for obtaining prompt adequate anticoagulant effects in the treatment of frostbite, a larger initial dosage such as 400 milligrams was employed at times in conjunction with local heat. In this manner anticoagulant activity was observed within an hour.



Graph 2 Coagulation time in Case 3 E.C.

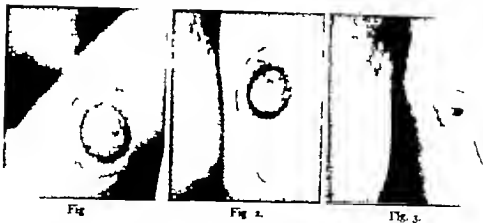


Fig. 1.

Fig. 2.

Fig. 3.

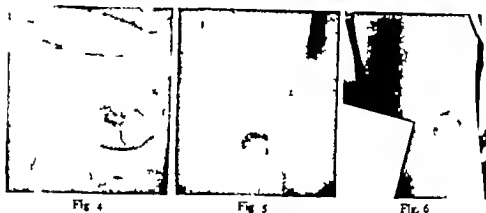


Fig. 4.

Fig. 5.

Fig. 6.

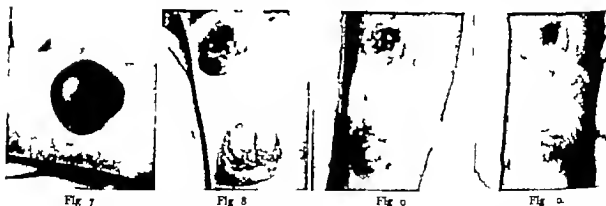


Fig. 7.

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 1. S.F. male. Two days after exposure to crucible filled with dry ice applied for 30 minutes to the upper arm.

Fig. 2. The same patient 4 days after the dry ice exposure.

Fig. 3. The same patient 7 days after the dry ice exposure.

Fig. 4. S.Z., male. Two days after exposure to crucible filled with dry ice applied for 30 minutes to the upper arm. Heparinization started immediately after the exposure.

Fig. 5. The same patient 4 days after the exposure and after the start of heparin treatment.

Fig. 6. Same patient 7 days after the exposure and 3 days after termination of the heparin treatment.

Fig. 7. E.C., female. Two days after exposure to crucible filled with dry ice applied for 30 minutes to the upper arm.

Fig. 8. Same patient 8 days subsequent to the initial exposure and 4 days following a second exposure under the same conditions but which was followed immediately by heparinization.

Fig. 9. Same patient 20 days after the first exposure and 14 days after the second exposure which was followed by heparinization.

Fig. 10. Same patient 27 days after the first exposure and 3 days after the second exposure followed by heparinization.

The practical demonstration of the therapeutic value of the method was made possible in our study of artificial frostbite in eight human volunteers. In one group the frostbite was accomplished by means of a porcelain disc filled with dry ice and applied with pressure, to the skin of the lateral aspect of the upper arm for 10 minutes. An area about 2 centimeters in diameter came in contact with the skin. By this method a temperature of approximately minus 22 degrees C was achieved. Heparinization was started immediately following the exposure. One volunteer served as a control. The other group was subjected to local refrigeration in the same manner but for two exposures of 30 minutes each. The initial or control exposure was permitted to develop for 6 days before the second frostbite was induced immediately following which, treatment with the subcutaneous heparin in the Pitkin menstruum was initiated. The 30 minute exposure with dry ice results in temperatures considerably below minus 22 degrees C and is comparable as to the degree of exposure, to the frostbite suffered by aviators in high altitude flying such as nose gunners after demolition of the plexiglass protection or gunners attempting to unjam guns without glove protection.

The metamorphosis of the untreated lesions and the repair following heparin therapy are shown in the following illustrated cases.

CASE 1 S.F. male aged 33 years control case. The patient was suspected of having subacute bacterial endocarditis although no organisms had been recovered from the blood stream on repeated trial. He had been accepted for treatment with penicillin and heparin, which however had not as yet been started. A 10 minute application of dry ice produced a frosted depressed area 2.5 centimeters in diameter with surrounding raised erythematous zone 0.5 centimeters wide. The refrigerated area was frozen stiff. About 2 hours later the area of central depression was pink and elevated with a small zone of surrounding erythema. The following day the peripheral erythema about the frozen area had disappeared. The lesion was gray brown with superficial vesiculation and had become completely anesthetic (Fig. 1). By the fourth day the central gangrenous area with surrounding hyperemic zone had progressed further (Fig. 2). The lesion on the 17th day appeared as a healing lesion with the exception of a small central necrotic, ulcerated crusted area about 3/8 of an inch in diameter (Fig. 3).

CASE 2 S.Z. male aged 35 years suffering from subacute bacterial endocarditis due to a gram negative anaerobic coccus of the *Vellionella* group. He had several courses of penicillin heparin therapy and was at the time in a post therapeutic observation period. He was given a 10 minute exposure similar to that given S.F. following which he was immediately given 400 milligrams of heparin subcutaneously without vasoconstrictors (2 LP 11 Table 1). The coagulation time rose promptly to almost 40 minutes from a control of 18 minutes (Graph 1). The following day another 400 milligrams was given despite an adequate coagulogram of about 25 minutes in order to bridge the initial critical period with optimum anticoagulant responses. He was given another deposit of 350 milligrams (LP 11 plus LP 13) 48 hours later and 48 hours after that a final 300 milligrams (2 LP 13). The graph indicates constant and satisfactory heparinization. After 24 hours the initial depressed area was raised gray brown in color with a superimposed vesicle about 1 centimeter in diameter (Fig. 4). Four days after exposure there was marked hyperemia of the exposed area (Fig. 5). The entire lesion resolved without necrosis as shown by a comparable photograph taken on the 17th day following the exposure where almost complete healing is indicated (Fig. 6—see control Fig. 3).

CASE 3 E.C. female aged 21 years suffering from subacute bacterial endocarditis due to *Streptococcus viridans*. She was given a control frostbite by exposure to dry ice for 30 minutes. Two days after this exposure an enormous blister involving the entire lesion was at its height (Fig. 7). Six days after the control frostbite was produced, a similar 30 minute exposure was effected below the control area immediately following which 300 milligrams of heparin in the Pitkin menstruum without vasoconstrictors (2 LP 13) was deposited subcutaneously in the lateral aspect of the thigh. The coagulation time rose from a control of 12 minutes to 33 minutes (Graph 2) and dropped to 22 minutes the following day at which time an additional 300 milligrams (2 LP 13) was given with a prompt rise to 42 minutes. Thereafter, 300 milligrams (2 LP 13) was deposited every other day. Heparinization was constant and adequate with the exception of the 6th day. However it is more than likely that the effective therapeutic was accomplished within the span of the first 6 days.

Eight days after the control exposure the untreated lesion appeared as a large ruptured bulla with an indurated base. Necrosis was also evident. Two days after exposure, the heparinized frostbite lesion was large, bullous and without induration (Fig. 8). Necrosis of the control untreated area was still fairly extensive 10 days after exposure but the heparinized lesion 14 days after exposure showed merely hyperemia and dilatation of the blood vessels without loss of tissue (Fig. 9). The complete necrosis of the untreated area is effectively portrayed 27 days after the control exposure. This

contrasts with the almost complete healing of the treated heparinized lesion 22 days after exposure (Fig 10)

SUMMARY

1 The functional pathology of frostbite is discussed and the early heparinization of patients with such lesions is suggested.

2 Heparin in Pitkin's menstruum deposited subcutaneously or intramuscularly is a simple and satisfactory method of achieving effective anticoagulant responses

3 Eight volunteers were exposed to small areas of frostbite by the use of dry ice. None of them developed any tissue loss when ef-

fectively treated with subcutaneous heparin while the control lesions showed central necrosis.

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MILITARY SURGERY—UNITED STATES ARMY— EUROPEAN THEATER OF OPERATIONS, 1944-1945

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MISSION OF UNITED STATES ARMY MEDICAL DEPARTMENT

THE Medical Department of the United States Army has a threefold mission—first, evacuation of the wounded, both from the battlefield where their presence jeopardizes morale and from the Army hospitals, where their care infringes upon the mobility and supply of combat forces. The second function is that of professional medical care. For this purpose an organization must be set up that brings the battle casualty and the medical officer together and provides the medical officer with those facilities necessary for such care. The third function is that of the restoration of injured men to combat. The number and percentage of wounded who can thus be returned to combat may in a war of attrition dictate success or failure. The medical departments of other armies may have other objectives—certainly, our inability to capture wounded Japanese in any number suggests that the medical department of the Japanese Army has a different mission.

ORGANIZATION OF ARMY MEDICAL DEPARTMENT EUROPEAN THEATER OF OPERATION

To accomplish this threefold mission there must be a carefully integrated organization and some understanding of this is desirable if one is to appreciate the results which it has achieved. A primary consideration is the complete interdependence of administration and professional care, on which depends its effectiveness. The civilian doctor is prepared to expend every ounce of energy and all of his time on a single patient, knowing that others can be found to care for additional injured or sick people who might present themselves at the same time. This policy when one is confronted with thousands and

not individuals must be forgotten in the greater good for the larger number. This change of outlook from the individual to the mass is the chief difficulty confronting the civilian doctor when he enters military service. Moreover if the three functions of the Medical Department are to be fulfilled—evacuation medical and surgical care and restoration to combat fighting—attention must be focused more and more on those who can be returned to duty. By so doing eventually a greater good for humanity will be achieved for if large numbers of men can be restored to the fighting forces, war will end sooner and thus humanity suffer less. This need not result in neglect of the severely damaged soldiers.

The organization for medical care in the United States Army begins at the battle front and extends through to hospitals in our communications zone in a theater of war, from which the soldier may be returned to the combat forces or through to hospitals for rehabilitation in the United States of America. Charts 1 and 2 present graphically the course of the casualty from front to rear. The care of the wounded soldier begins on the battlefield there Company Aid men render first aid care. They control hemorrhage, dress the wounds, initiate sulfonamide chemotherapy, control pain with morphine, splint fractures and evacuate the wounded to the Battalion Aid Stations in the forward part of the combat division. The devotion and training of the medical soldier—of whom more than 2000 have been killed in action in this theater—has been a major factor in the good results achieved by the medical department in this theater. At the Battalion Aid Post where there is a medical officer in attendance, dressings are checked, splints readjusted, plasma is available if required, tetanus toxoid should be given, and the field medical record if it has not been initiated by the Company Aid

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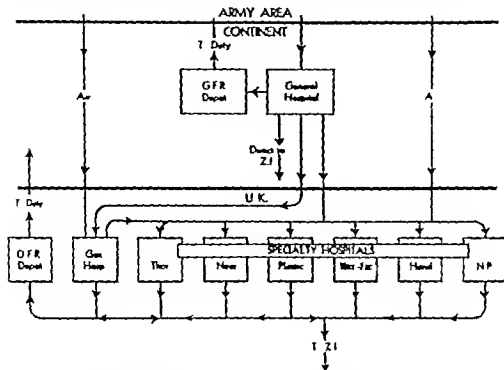


Chart 2. United States Army Medical Organization. II Communications Zone (Continent and United Kingdom.)

dize their opportunity to survive. Such may be those with multiple serious fractures. All other battle casualties by pass the Field hospital and go further to the rear to an Evacuation hospital. Thus sorting at the Clearing Station is a function of greatest importance and must be by experienced officers.

At the Clearing Station whole blood is available, and those who can travel following a transfusion of blood and/or plasma receive such treatment there. Also at this level treatment with penicillin is begun and from this point to the rear penicillin is available for regular parenteral injection. In the early part of the recent campaign sulfonamide therapy begun on the battlefield by the Company Aid man was continued to the Evacuation hospital, and a majority of individuals for a few months received simultaneous treatment with the sulfonamides and penicillin. As time passed and penicillin was in liberal supply the continued medication with sulfonamides gradually diminished until now it is practically reserved—other than the initial dose on the battlefield—for areas where penicillin is not available.

Each Army controls two special medical units—a Convalescent hospital and an Auxiliary Surgical Group. The Convalescent hos-

pital has 3 000 beds and usually has a policy permitting the holding there of soldiers who may be returned to duty within 10 or 14 days. If sick and wounded require a longer period they would not stop at the Convalescent hospital but pass to hospitals in the Communications Zone. The Auxiliary Surgical Group is an assemblage of 61 surgical teams the majority of which are headed by general surgeons though there are attached special teams in orthopedic surgery, neurosurgery, thoracic surgery, maxillofacial surgery and the treatment of shock. These surgical teams do the professional work in the Field hospitals, which are not staffed with expert surgeons and also bolster up the Evacuation hospitals where there may be an insufficient number of surgeons for the load imposed. The professional abilities of these team surgeons have played a major role in the diminution of mortality rates. The rapidity with which younger surgeons improved their technique and acquired judgment is a great tribute to their fundamental training in the medical schools of the United States of America. The existence of such an organization permits the movement of surgical teams at any time to an overloaded hospital and effects a saving in highly trained professional personnel.

The organization for care in the Communications Zone (Chart 2) is built around the professional work in General hospitals. These are ordinarily 1,000 bed institutions, capable of expanding to 1,500 beds but may be larger. Such General hospitals are frequently grouped together in what are called Hospital Centers which greatly increases the flexibility of care and evacuation and decreases the number of highly trained personnel required. Thus, if ten hospitals can be grouped together a service can be established in selected hospitals for the care of special types of injury. These are generally divided into centers for thoracic surgery, neurosurgery, maxillofacial and plastic surgery, and for the care of those injured in the hand. Because of the local situation in this theater we provided ourselves with hospitals of this type both on the Continent and in the United Kingdom. Early in the campaign all of the centers for such specialist care were in the United Kingdom and in these special hospitals the greater percentage of such care was accomplished. This grouping of casualties under highly trained experts led not only to splendid care of the individual case but provided sufficient material to permit critical evaluation of methods of therapy which led to a steady improvement in our technical procedures. Finally from hospitals in the United Kingdom or on the Continent evacuation both by air and sea had to be provided for the patients who could not be returned to duty and who should be returned to the United States of America.

This entire system of hospitalization is flexible, for it must vary with the military situation, since the tactical action and the numbers of casualties resulting from such activity dictate the theater policy for evacuation. Almost to the end of the campaign this theater functioned under a theater policy of 120 days, which meant that any sick or wounded soldier who could be returned to duty within 120 days could be held in the hospitals of the European Theater of Operations. Because of the difficulty of evacuating soldiers to and from the United Kingdom an additional policy was established relating to which cases should be hospitalized in the United Kingdom and which should be held in Continental hospitals.

As a rule long term cases went to the United Kingdom, and those who could be shortly returned to duty remained in Continental hospitals but when casualties were reaching between 40,000 and 50,000 per month, and when the Continental hospitals could not hold all those who would be returnable to duty in 60 days, or even in 30 days, modification of the policy came into being and many who were returnable to duty in 60 days or even less had to be evacuated to the United Kingdom and then brought back to the Continent when ready for duty. Similarly it was inevitable that in the rush of work (60,000 patients were moved by air in May) individual casualties who perhaps could never have been returnable to duty even in 120 days, were mistakenly routed and had to be held in our Continental units but these incidences must be looked upon as unusual.

All this emphasizes that only the perfect interdigitation of administrative and professional personnel can lead to a happy solution when thousands of wounded men are handled daily. Professional personnel must be informed where the load is to be borne, how long casualties can remain in one hospital, and what methods of evacuation are to be used if proper care is to be given. And personalities must be forgotten. In spite of difficulties, the professional group always attempted to carry out the policies set by the chief surgeon, both those which placed a time limit on professional care and that which demanded of us that the American soldier be given the best care possible under the conditions imposed by the military situation. Administration must set evacuation and hospitalization policies, but these policies and the burden they impose are borne by others. Good results will accrue only when both are completely informed of the labor and responsibility of the other. Directives are no substitute for good briefing, whether the goal be tactical or medical.

Sorting at the Clearing Station has already been dealt with. Further sorting is carried out in the Field hospital. Here with each admission an appraisal of the patient's condition will dictate what kind of resuscitation is necessary, whether the presence of a tourniquet demands immediate priority for the oper-

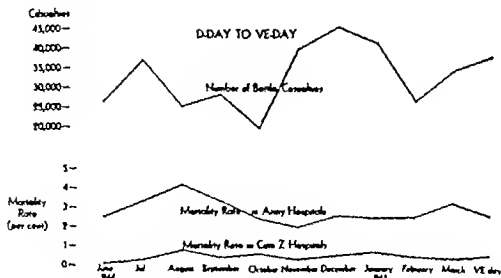


Chart 3. Battle casualties, Medical Department, European Theater of Operations, excluding K.I.A. Total battle casualties, 372,556; mortality rate, 3.9 per cent.

ating room or whether the missile's course and lodgment requires an x-ray examination before the surgical ordeal.

Again, after the surgical intervention further evaluation and sorting distinguishes between those who can stay and those able to be evacuated. The same kind of sorting evaluation, and triage must go on in every hospital. Let us consider the importance of proper sorting at the first General hospital the casualty enters after leaving Army installations. Here a dual function confronts the hospital—the wounded who have slipped through the Army hospitals without primary care must be given that care and those who have received primary care and those now given it in this hospital must be routed after sorting according to the evacuation policy at that time. Again consider the less busy General hospital in the rear-most area. Casualties may reach this hospital on the third or fifth day. The question immediately arises—which wounds can be sutured and which must be left open? All military surgeons must recognize that this constant evaluation and sorting into special categories for evacuation or professional care is a major function for the medical officer.

STATISTICAL DATA ON MORTALITY RATES AND DISPOSITION

Certain statistical data are presented at this point not to emphasize the immensity of the task now just completed but to demon-

strate that the results achieved in this war differ sufficiently from those in World War I to demand an estimation of the factors that have brought about these improvements. Also lessons may be drawn that will benefit our casualties resulting from the growing conflict in the Pacific.

Chart 3 summarizes the United States Armies European Theater of Operations total wounded in action casualties from D-day through V-E-day and presents the overall mortality rate of these casualties in medical installations. This mortality rate of 3.9 per cent in 372,556 battle casualties is approximately one-half of the rate in the first world war. Of the 3.9 per cent mortality, about 0.5 per cent die within the medical elements of the combat division (Battalion Aid Post, Collection Station or Clearing Station), 2.7 per cent die in Army hospitals (Evacuation and Field hospitals) and less than 1 per cent in General and Station hospitals in the rear area.

The next three charts present comparative statistics for anatomical woundings. Chart 4 compares the regional distribution of the wounds in the casualties reaching medical units alive in the United States Civil War, World War I and World War II. The increased percentage of wounds of the thorax and abdomen in this war as compared to World War I represents in part a higher survival rate, possibly through better care on the battlefield and better evacuation. Some of

directly contributing to the improvement of morbidity and mortality statistics, is the resuscitation of the wounded man. This transcends in importance any single method of therapy, such as our ability to procure and deliver blood and plasma to casualties, for it betokens that the American surgeon has at last appreciated the importance of the complete evaluation of his patients before therapy. He has learned to care for the whole of man and not for any fragment or any particular wound. This, in turn, has led to proper resuscitation and the better care of shock. Accretions to our knowledge concerning shock have come in steadily as experience has been acquired. Dependable studies of blood volume made in forward hospitals indicate that soldiers seriously damaged have averaged a loss of at least one-third of their total blood volume, and investigators have tried to set simple standards for recognizing this deficiency. Majors Emerson and Ebert have stated that a blood pressure below 85 systolic usually betokens a loss of over one-third of the total blood volume. Professor McMichael of the British Post Graduate Medical School has stated that in the male thigh an increase in diameter of some 2 centimeters which, to the cursory glance would not seem great, may mean that 1500 cubic centimeters of blood are outside of the capillary bed and actually beyond the vascular tree.

This is a matter of great importance. Surgeons are apt to think that only when there is visible blood loss is the condition of the patient jeopardized but it can be seen that 3000 cubic centimeters of blood may be lost from the circulation when there are wounds in both thighs, without more than a few drops leaving the body. It is this overall appreciation of diminution in the amount of circulating blood and this overall desire to look at the whole man and not the wound alone that has led to our greatest advance in this war. From May 22, 1944 to May 31, 1945 385,231 pints of blood have actually been used in medical installations in the European Theater of Operations. Of this, 194,712 pints were flown directly from the United States of America. This blood has been available as far forward as the Clearing Stations in Combat Divi-

sions. It has been used largely in the Field and Evacuation hospitals in the forward area at the time of primary surgical therapy and has been used in great quantities, up to 6 or 7 liters in a single individual in one day. This widespread use of blood through its easy availability has brought in its train inevitable reactions, as well as great benefit. The best figures available at this time show that about 4.8 per cent of transfusions are followed by some kind of reaction: allergic reactions, 0.9 per cent; pyrogenic reactions, 3.7 per cent; hemolytic reactions, 0.1 per cent. The reactions vary in different types of institutions, and vary as to whether the transfusion is given early or late. As a rule, primary transfusions have brought little reaction. Later transfusions, given in General hospitals, have often found the patient sensitized by the earlier transfusions. Pyrogenic reactions have increased where hospitals insisted upon cleaning their own glassware and not using sets furnished to them already clean and sterile. As time has gone on reactions have diminished, probably because of better technique, better refrigeration of the blood and through our ability always to furnish giving sets properly set up and sterilized at some central point. A particularly valuable study of these reactions following transfusion has revealed that the transfusion of large amounts of group O blood (the universal donor) and even of pooled plasma may result in serious hemolytic disease. The implication is strong that, whenever feasible, strictly compatible blood of the same group as the patient should be used; that where large amounts of group O blood must be used, only blood of a low titer should be administered. Such information as this, and other studies now in process, will doubtless have some influence on the future set up of blood banks in civilian life.

Chart 9 depicts the use of the varying anesthetic agents in over 360,000 cases. It is of interest to see as would be expected that the inhalation anesthetics are largely used in the forward hospitals for nontransportable casualties, comprising almost 45 per cent of all anesthetics in Field hospitals. This is because a high percentage of the wounded there are injured in the thorax and must have endotra-

CHART 9—ANESTHETICS ACCORDING TO METHOD USED JUNE 1944 THROUGH
FEBRUARY 28 1945 EUROPEAN THEATER OF OPERATIONS

Hospital	General %	Station %	Evacuation %	Field %	Total	Total %
Intubation	6	13	1.8	44.7	11706	8.7
Field block	26.4	21	6.5	1.8	2638	27.7
3. Miscellaneous regional	1.0	8	4.7	3	43	.8
4. Spinal	0.	13.3	6	4.6	3.25	3.3
5. Sympathetic	6				4980	3
6. Intravenous only	26.5	20	44	30.	11903	36.8
7. Intravenous combined	7.5	7	8	6.8	5.05	4
8. TOTAL	10400	484.6	9320	24.8	261400	34.
Endotracheal	1	1.3	2.7	28.5	31	

cheal anesthesia. Another comment is suggested by the increasing use of regional or local anesthesia. It would seem that regional anesthesia is not, *per se* the anesthetic of choice when a wound must be widely debrided and much tissue excised. Regional anesthetics tend to limit the surgeon. They may thus result in inadequate débridement of the wound and unless there be other contradictory evidence it would seem wiser to render the patient insensitive as a whole for complete toilette of the wound. The high percentage of procedures carried out under intravenous (pentothal) anesthesia represents the usefulness and desirability of this method.

The débridement of the wound is the most important surgical task. It is of major importance for the end result, both as to life and as to function. If properly done it should obviate serious infection. It may preserve a limb from amputation and if blood supply is intact and major nerves undamaged will leave good function. In the first place the surgeon should always attempt to visualize the position of the patient at the time of the injury. This has been difficult to teach. Thus, a wound over the heart does not necessarily mean that the soldier is wounded in the heart for if the soldier was lying down the missile may have traveled a great distance under the skin and have done almost no damage and emerge close to the hip joint. Similarly if the arm is flexed when hit but operated upon in the extended position the tract of the missile cannot be properly débrided unless the arm is again placed in the flexed position as it was when the missile traveled across the bellies of the

muscles. We have watched a young surgeon attempting to find a missile in the inner condyle of a knee—a missile which entered when the knee was in the flexed position but the surgeon was operating upon his patient with the knee extended and thus failed for some time to locate the course of the missile and therefore unnecessarily damaged an important joint surface.

Another matter which must concern all military surgeons is what can be spoken of as wound ballistics or the application of physics to wounds. As early as 1914 it was shown that there was a definite relationship between the extent and severity of a wound and the kinetic energy (*i.e.* mass or size times velocity) of the missile producing the wound. The criterion put forward originally was that 58 foot pounds of energy were required to produce a casualty. However this original criterion was based on observations pertaining to bullets weighing an ounce or more. During the present war investigations have been carried out on the wounding power of very small high velocity fragments and it has been proposed that a new casualty criterion be set up on the momentary cavity which these missiles produce in tissues or experimental media. Although surprise has often been expressed at the large cavitation produced in soft media when a small missile passes through it it can be shown that this cavitation is to be expected and that the same physical principles apply to its formation in soft and hard media ranging from soft gelatin to hard steel.

When a missile passes through a medium that portion of the medium which lies just

ahead of the missile must move aside with a velocity somewhat less than, but comparable to that of the missile that has imparted some of its energy to the tissue. The extent of radial movement or cavitation of the tissue in the path of the missile depends upon the strength of the restoring force of the medium. Thus, the restoring force of steel or the tendency of the elasticity of the steel medium to reverse its direction of movement is great and the distance it moves radially along the path of a missile is minimal doubtless in most cases a small fraction of a millimeter. In contrast with steel, whose restoring force is approximately 100,000 times greater than 20 per cent gelatin (which is comparable in density to human skeletal muscle) in the latter a momentary cavitation is produced along the path of a missile passing through. Associated with the cavitation produced by a missile passing through a medium at a high velocity there is considerable damage to the medium at considerable distance from the missile tract. In instances where the medium is living tissue nerves vessels and even bones may be severed or broken when a high velocity missile passes in the proximity of but not necessarily through such a structure. An appreciation of these facts is essential to proper débridement of a wound and explains the necessity for wide débridement.

Let us now consider the actual carrying out of the débridement of a wound. In the first place proper preparation of the skin over a wide area must be performed. Soap and water is satisfactory but any good detergent such as ether gasoline or zephyran may be used. This may be followed by alcohol or if the surgeon is wedded to dyes, merthiolate. Next, the incision must be in the long axis of the body and sufficiently long to expose well every recess of the wound. A minimum of skin should be removed partly because skin is essential to proper early closure of the wound but also because skin itself is not alone the site of widespread infection. Only a minimum of 2 or 3 millimeters at the contacted edge of the tract need be cut away. Fascial planes below this should be widely opened and where there is tough fascia as in the thigh, it is better to cut this transversely as

well as longitudinally. When one is concerned with the next layer muscle, the major problem arises in the proper débridement of a wound. All devitalized and dead muscle should be excised. Hesitation to do this often results in disaster. Live muscle is determined by its ability to contract and by its color. If the wound is filled with salt solution after hemostasis dead muscle loses its color more rapidly than living muscle and all frayed fragments can be more easily detected. Once the surgeon is satisfied with the muscle excision which must in perforating wounds, involve both aspects of a limb he must carefully determine the condition of the nerves and blood vessels. These are the most important elements in an extremity. Blood vessels should never be ligated when the opening can be closed by a suture and if ligation seems essential, some form of tube if available should be inserted. The idea is to permit some blood to enter the extremity for at least 3 or 4 days until the collaterals have been given time to dilate and take over normal blood flow. In our opinion, heparinization of casualties, when there is the possibility of internal concealed hemorrhage, or where there are multiple wounds, carries too high a risk of secondary hemorrhage, and should be condemned.

Next one must be concerned with the nerves. If these are divided it seems wiser to approximate them loosely with a single loop suture of metallic substance such as tantalum. In order that one may find the severed nerve at the time the nerve suture should be carried out and to prevent their retraction to the deeper recesses of the wound. Suture of the nerve at this time in a contaminated area is not good therapy and in fact, it has been shown that the axis sheath is much more likely to accept and guide new processes into the sheath after an interval of 3 to 6 weeks.

Bony fragments, unless they are absolutely loose and unattached to the periosteum, should not be removed, for now that the danger of infection has been mitigated by the advent of the sulfonamides and penicillin we must leave every piece of viable bone in the wound in order that nature may reconstruct the damaged part herself. No bone graft can ever hope to equal natural healing. All soft

tissue wounds not leading to the cavities with in the skull the thorax and the abdomen must be left open in spite of modern chemotherapy infection remains a major risk which is vastly increased by primary closure of the wound.

Finally, the dressing As experience has accumulated it is obvious that much damage is done by packing wounds open. Ideally in very deep wounds a small slip of rubber tissue should suffice for the escape of tissue juices or a single piece of vaselined gauze might be left in such wounds. Next the wound must be properly bandaged. The advent of adhesive plaster has lost to the surgeon much of his art as a dresser, but the ideal dressing was well described by Sampson Gamgee almost 100 years ago, it should cover the wound completely and extend well beyond the wound to keep out further contamination. The dressing should contain enough substance so that when the bandage is applied it will be elastic and give gentle compression and comfort to the part. In turn, if the part is elevated swelling is diminished circulation is improved and pain is minimized as the sensitive tactile end organs are no longer stimulated by pressure. In the greater wounds it is wise to add further means of immobilization. This may be only a splint, or better a light plaster shell. The value of this immobilization of recently damaged tissue was perhaps overemphasized by the Spanish school, which felt that a limb should remain in plaster of paris until healing of the bone took place. Such prolonged immobilization led to a neglect of proper alignment of bone, though it did possibly assist, in the days before the sulfonamides and penicillin in decreasing the spread of infection. This debilitation of the wound is a major element in happy results. Chemotherapy has, indeed revolutionized modern military surgery and opened up immense possibilities in the earlier and more complete restoration of function. But chemotherapy cannot effect sterilization of dead and devitalized tissues surgery alone can be useful in such circumstances.

THE SURGICAL SPECIALTIES

Great advances have come during this war in each specialty. There are differences of

opinion as to whether the specialist has a place in the forward zone but the answer depends upon the definition of specialization. All surgeons whether they be in a narrow specialty or a large one should have first a broad general training in surgery. If this is the training of the specialist then he may be immensely valuable in the forward area.

Thoracic surgery has already laid down certain incontrovertible dicta for military surgery. First, conservatism in the forward area only, sucking wounds of the chest and pressure pneumothoraces and the greater wounds must be dealt with forward the majority of thoracic wounds except for the great necessity of keeping the pleural space emptied of blood do better with a period of delay and the more elaborate procedures when they seem necessary carried out in specialized hospitals in the rear area. The advent of chemotherapy has resulted generally in a decrease of serious infection in this field for work. A special word must be said for decortication of the lung a procedure which has proved satisfactory up to the third and even later than the fifth week following injury and also even when a very considerable amount of infection is present. The removal of a clotted hemothorax and decortication bears some relation to the removal of a subdural hematoma and indeed it may be that the increasing size of clotted hemothoraces bears a similar relation to the increased osmotic action of broken down hemoglobin as it does in intradural hematoma.

The field for neurological surgery has made great advances. In our Army those operated upon in the forward area are largely those actively bleeding threatened with increasing intracranial pressure or with very large retained missiles. It has been observed that less serious intracranial damage withstands transport very well and that in patients properly treated with penicillin the advent of serious infection is no greater when such patients must wait 3 to 4 days before reaching a hospital for specialized care in the rear area. In the field of peripheral nerve surgery equally important advances have been made. Our surgeons have made every attempt to close wounds as early as possible, and in the large percentage with nerve damage have sutured

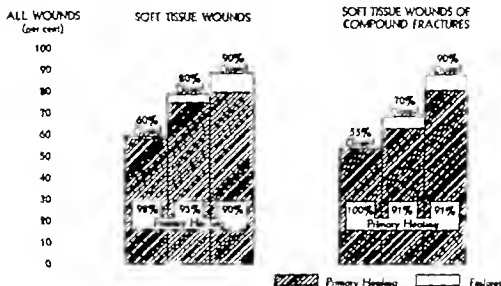


Chart 10. Increased "salvage" with great proportion of secondary closures attempted.

procedure. Such a closure should be spoken of as delayed. It is not a secondarily closed wound because it was never closed before. It is not delayed primary closure because there has been no primary closure. We have had a large experience in this field. All our hospitals are instructed to close wounds at any time after the third or fourth day. The optimum time is certainly before 10 days, when granulation tissue and cicatrization have already begun to defeat any attempt to draw together the lips of the wound without a secondary cutting operation. It may be stated that around 75 per cent of all wounds are solidly healed 2 weeks or less after the delayed closure and that at 3 weeks 90 per cent are solidly healed. Variations in these percentages will occur with individual hospitals. The most difficult task in this field has been to persuade our surgeons to attempt to close all wounds. Some surgeons report statistics where 95 per cent of their wounds thus closed healed *per primam* but some of these surgeons do not attempt to close all wounds and the figures for the attempted closure of all wounds which represent the salvage for the Army are the only ones of importance. Chart 10 reveals interesting data in this special field collected from several different hospitals. When 98 per cent of soft tissue wounds healed *per primam* only 60 per cent of all wounds were closed when 90 per cent healed *per primam*.

Based on representative data from various General Hospitals.

90 per cent of all wounds were closed. In the latter hospital, though the healing rate was not so high, the ultimate salvage for restoration to duty was 20 per cent greater.

In the closure of wounds of compound fractures it is again evident that attempts to close wounds should be more universal even if a lower percentage of wounds heal *per primam*; the salvage for future duty is greatly increased when this is practiced.

REASONS FOR IMPROVED STATISTICS

It would be impossible at this time to evaluate and put in proper perspective the reasons why the mortality rates in the United States Army in World War II are one-half as great as those in World War I but there is every reason to believe that the following have each played a rôle.

1. *Resuscitation* The proper treatment of the patient in shock, chiefly by the use of plasma and blood.

2. *Better first aid* by the Company Aid man on the battlefield.

3. *Penicillin and the sulfonamides* which have vastly reduced the horror of infection.

4. *Improved methods of transport and evacuation* which allow earlier meeting of surgeon and casualty and more comfortable travel.

5. *Good general physical condition of the soldier*. This may be partly diet or it may relate to the physical training to which he has been subjected before battle.

THE ORIGIN, FREQUENCY AND SIGNIFICANCE OF MICROSCOPIC CALCULI IN THE KIDNEY

LEO ANDERSON M.D. and JOHN R. McDONALD M.D. Rochester Minnesota

ALTHOUGH considerable interest has been focused on the pathology of the renal pyramid by the studies of Randall and other workers we have been unable to find any published material quoting the exact frequency of microscopic calculi in the pyramids of the kidneys or an adequate description of their origin morphologic characteristics or possible significance. Most of the significant work has been done on the *macroscopic* patches or plaques appearing on the surface epithelium of the pyramid which points into the cavity of the renal pelvis.

We shall therefore define a microscopic calculus as a deposit of calcareous material appearing in the substance of the kidney of a size sufficient to be seen easily under the ordinary low power microscopic lens and measuring at least five to six times the size of the tubular cells.

For the original purposes of this study unselected diseased kidneys removed surgically at the Mayo Clinic provided a basis for the conclusions. Kidneys which had been removed because of tuberculosis pyelonephritis hydronephrosis or stones were studied. As the work progressed it became evident from the findings that grossly normal kidneys removed at necropsy should be included. Accordingly such a group was secured and studied in the same manner.

Careful histologic search was made for microscopic calculi in each pyramid, after the pyramid was cut sectioned stained with hematoxylin and eosin and mounted. Calcareous deposits were sought on the basis of the foregoing definition. When a calculus was found, careful scrutiny as to the possible histogenesis was carried out. If the particular pyramid in one kidney did not show a plaque

further sections from other pyramids of this same kidney were studied in an effort to find such a lesion. This procedure was continued until the calculi were found in each kidney or their absence was shown beyond a reasonable doubt.

Randall noted the microscopic plaques and wrote: "The vast majority of papillary calcium salt deposits have been found to be intra papillary and innocent of further pathologic change."

Vermooten made histologic preparations of the papillae from 103 kidneys which showed the grossly visible plaques on the surface epithelium of the pyramid. He noted the deposition of calcium in the collagen fibrils of the renal papillae in many of the sections but he did not state the exact frequency of this finding.

In 1862 Henle recognized deposition of calcium salt in the renal substance. He termed these deposits calcium infarcts and pictured the lesion as a complete filling of the tubules with chalk.

In 1904 Beer made a macroscopic and microscopic study of 100 kidneys removed at necropsy and concluded that deposits of lime in the kidney were a very common pathologic condition. He stated that lime is found in the tubular epithelium as fine granules. He found the deposits only in the parts of the kidney which he felt were diseased. He spoke of the lime being deposited in fine granules throughout the parenchyma of the kidney. He found calcium deposits in 53 per cent of his 100 cases but never among persons less than 24 years of age.

In 1933 Huggins studied surgically removed kidneys all of which had come to operation because of massive stones. He described deposits of calcium beneath the epithelium of the collecting tubules.

W. Anderson reported on a study of tiny single or multiple deposits of calcium salts in

From the Division of Surgery, Mayo Foundation, and the Division of Surgical Pathology, Mayo Clinic.

Abdication of the submitted by D. Anderson to the Faculty of the Graduate School of the University of Minnesota, in partial fulfillment of the requirements for the degree of M.S. in Surgery.

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Fig. 1. Section of pyramid from a pyelonephritic kidney. *a* represents a small coalescing plaque of the type considered as minimal evidence of positive calcareous deposition. *b* is phagocytic cell with tiny bit of ingested calcareous material and *c* are interpreted as bits or "flecks" of calcareous material which may subsequently be absorbed by phagocytic cell. *d* represents "droplets" about which can still be seen remnant of the phagocytic cell membrane represents "droplets" which have lost all cell membrane but which have not yet coalesced into microscopic calculus. $\times 650$.

the cortex or medulla of the kidneys from 1 500 necropsies. In most of the cases a single section of each kidney was studied microscopically; the section containing a portion of cortex, medulla, and renal papillae. He reported 12 per cent as showing microscopic calcium deposits. He felt that microscopic

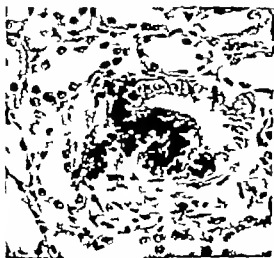


Fig. 3. A tiny calculus which is situated just outside the tubule and seems to be pressing on the still intact lumen of the tubule. $\times 300$.

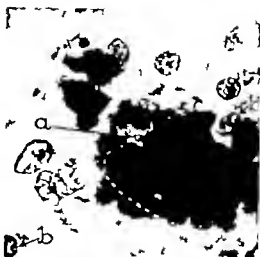


Fig. 2. Coalescing stage. Section of renal pyramidal which clearly demonstrates plaque which is made up by the coalescence of many droplets, each containing calcareous material. The outline of all the droplets can still be seen. In some the cell outline is still visible. *a*, The microscopic calculus about the border of which can be seen the outlines of the droplets. *b*, Phagocytes containing bits of blue-black calcareous material. $\times 900$.

calcium was more likely to be deposited in the cortex than in the medulla or papillae.

In 1940 Roscnow reported a study of the kidneys from 209 consecutive necropsies performed at the Mayo Clinic. Particular search was made for the grossly visible patch on the tip of the papillae. He then selected 24 papillae which did not show evidence of gross plaque formation and studied these histologically. Only 4 of the 24 papillae showed intramedullary calcification.

Kjellhede and Lassen examined 135 kidneys removed at necropsy and stated that in 49 of the cases neither macroscopic nor microscopic examination revealed deposits of calcium in or on the papillae.

Posey studied the papillae of 340 kidneys removed at necropsy and noted microscopic deposits of calcium in several of the cases.

ORIGIN OF MICROSCOPIC CALCULI

Calcareous deposits stain bluish black with hematoxylin and eosin. The lesions under discussion are not of sufficient size to require decalcification since they fix and section easily and are visible under the low-power microscope ($\times 100$). Photomicrographs are shown to illustrate the lesions.

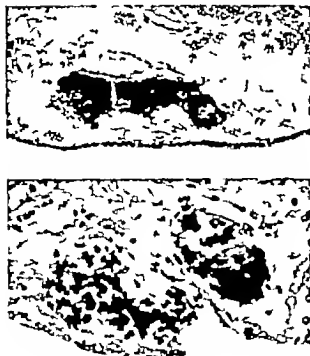


Fig. 4. *Amorphous stage.* a, above This microscopic calculus is located just under the epithelium at the tip of the renal pyramid. It is almost completely amorphous, showing none or very little, of the outline of the original droplets. It is situated where it might easily ulcerate through, remain attached and form the nidus on which the supersaturated salts of the urine of the calices might be deposited. $\times 130$. b, The epithelium overlying the calculus has been eroded away and the area is exposed to the urine of the calices. $\times 245$

Since these deposits were not described completely in any of the literature that we read the morphology and apparent developmental cycle of the plaques are outlined in this discussion in some hitherto unused terminology. These terms include flecks of calcareous material, droplets, ingestion stage, coalescing stage and amorphous stage.

Ingestion stage Phagocytic cells which are probably macrophages are abundant about the tubules of the kidney. Kirkman has made an excellent review of the work done on macrophages in the kidney. Phagocytes are shown in Figures 1b and 2b. Bits of blue black staining material can be seen in the cytoplasm of the cells. In Figure 1c and c can be seen flecks of calcareous material which have not yet been ingested by the phagocytes. This may be a result of the cohesion of reabsorbed calcium salts since there is a concentration of calcium about the kidney



Fig. 5. Microscopic calculi in the renal cortex. $\times 130$.

tubules. The ingestion stage refers to the process of ingestion of flecks of calcium by the phagocytic cells which are probably macrophages. This is assumed to be true on the basis of what is demonstrated many times in the sections used in this study such as that shown in Figure 1.

Coalescing stage These droplets of calcareous material clearly coalesce to form plaques. The still remaining borders of the many tiny droplets which went to make up the plaque can be seen still present about the borders of a high percentage of the plaques (Figs. 1a, 2a and 3).

Amorphous stage It appears from the study of many sections that the tiny calculus tends to become amorphous losing the semicircular outline of the original droplets which went to make up the entire plaque. Such a calculus is illustrated in Figure 4a.

Subepithelial calculi Figure 4a shows an amorphous plaque located just under the epithelium at the tip of the renal papilla. This is of the type which Vermooten has suggested may ulcerate through the epithelium and form the nidus for a stone according to Randall's hypothesis of formation of stone.

Figure 4b demonstrates the ulceration of the epithelium by a calculus which originated just under the epithelium. The calculus has ulcerated or eroded away the epithelium thus exposing the plaque to the salts of the urine.

TABLE I.—RESULTS OF THE COMPLETE STUDY ON THE GROSSLY NORMAL AND THE SURGICALLY REMOVED DISEASED KIDNEYS AS TO FREQUENCY OF THE MICROSCOPIC CALCULI

Type of kidney	Kidneys	Average number of sections per kidney studied to prove the presence of the microscopic calculi	Total number of sections made
Pyelonephritic	37	7	
Hydronephritic	26	11	33
Calculous	1	183	18
Tuberculous	24	18	97
Grossly normal	20	166	7
Total	68	244	650

All patients were 9 years of age or more. All kidneys showed the lesions.

Cortical calculi. The cortex of the kidney was not intentionally included in this study but in cutting pyramids the tissue of the cortex was frequently included. The interpretation placed on the finding of the calculi about the glomeruli is that reabsorption of calcium may occur in any part of the tubular system which includes of course the convoluted tubules.

Vermooten expressed the belief that these calcareous deposits occur in the collagen fibers of the renal papilla. With this we would have no argument except to point out that to us they seemed to occur anywhere (Fig. 5) except within the lumen of the tubule. A few specimens were found with the deposits within the tubules but it seemed to us that they had eroded into the tubule from the surrounding parenchyma. Caution must be observed in the interpretation of location since the studies in three planes which would have been afforded with serial sectioning were not used. Figure 3 shows a calculus which is outside the lumen of the tubule but seems to be pressing into the lumen and perhaps in time would have eroded its way into the tubule itself. It would have then been exposed to urine and might have grown to form an interparenchymal stone.

Randall Vermooten and Rosenow have very carefully followed the fate of the plaque after it appears grossly visible while attached to the tip of the renal papilla. That study is not a part of this work. *Macroscopic* plaques which were attached to the tip of the renal

papilla were observed but their frequency was not recorded.

FREQUENCY OF THE DEPOSITS

The results of the study as to frequency of the deposits are shown in Table I. On the average it was necessary to cut and study fewer than 4 histologic preparations on each kidney to prove the presence of the microscopic calculi in all of the kidneys. As many as 10 sections of some kidneys were cut before the lesion was found but in more than 50 per cent of the kidneys the calculi were found in the first section studied. We conclude that these microscopic calculi probably occur in the kidneys of all people above the age of 10 years. Kidneys from the very young were not made a part of this report. The age varied from 9 years to 79 years with a mean of 43 years.

It is interesting to note in passing that the conclusions of this work were arrived at by studying an average of 1/3,333 part of the total pyramid area of each kidney. This figure is easily deduced from the information that each section is only 10 microns (0.001 cm.) in thickness and the knowledge that each kidney contains about 10 pyramids each of which is about 1 centimeter thick. To study all of the papillary area of only one kidney might require as many as 10,000 sections. However this would probably not be necessary in actual practice, since the calculi probably extend over the thickness of many sections.

SIGNIFICANCE

Certain generally accepted postulates regarding the physiology of the kidney will be correlated with the findings of this work in suggesting an interpretation of the causation of kidney stones. These postulates will be defended by references to the work which has been done on physiology and pathology of the kidney.

Postulate 1. The concentration of calcium (and related ions) is high in the tissue fluid about the renal tubules.

Postulate 2. Phagocytic cells occur in abundance about the renal tubules. Most work indicates these to be macrophages. Macrophages have been shown to have a definite affinity for calcium.

Findings (1) Phagocytic cells are demonstrated in the process of ingesting calcium in the renal pyramid (Fig 1b ingestion stage) (2) 'Flecks' of calcium are shown about the renal tubules. These flecks are apparently outside the walls of any cells. (3) Droplets of calcium are shown within the confines of still present phagocytic cell membrane (Fig 1d) (4) Small calcareous plaques are shown about the edge of which can still be seen the rounded borders of the many droplets which went to make up this coalesced deposit (Fig 1a coalescing stage) (5) These microscopic calculi were found in all of the kidneys. The patients were all 9 years of age or more. The lesions were sometimes found in the first section made on a kidney. Sometimes as many as 10 sections were necessary to demonstrate this finding. On an average something more than 3 sections were made on each kidney. Six hundred and twenty nine sections were made of 168 kidneys. (6) Amorphous calculi were found which had entirely lost the outline of the original droplets or cells (Fig 4a amorphous stage) (7) Subepithelial calculi were found which had entirely lost the outline of the original droplets or cells and were located just under the epithelium at the tip of the renal pyramid (Fig 4a) (8) Deposits were found eroding through the epithelium at the tip of the papilla and yet remaining fixed to the papilla (Fig 4b)

Interpretation (1) The study suggests that these microscopic calculi occur in practically all people, as a result of the physiologic process of phagocytic ingestion of the reabsorbed calcium by the kidney tubules. (2) Renal calculus may be a systemic or a dietary disease and not a disease of the kidney *per se*. This assumption follows from the fact that although this tiny calculus which may act as a nidus, is present in practically all people not all people have symptomatic renal calculi. The finding of the tiny calculi in the process of ulcerating through the epithelium at the tip of the renal papilla and yet remaining firmly fixed to the papilla and bathing in the salts of the urine of the calices and receiving deposits therefrom would seem to substantiate the findings of Randall Vermooten and others that these plaques may form the nidus of

renal calculi. This seems especially striking when it is considered that only a small part of the actual pyramidal area of each kidney was actually studied in this work ($1/3$ 333) and yet all kidneys were found to have these tiny microscopic calculi. The answer may lie outside the kidney itself. We may suppose that some substance appears in the urine or blood which acts as a catalyst to the formation of a stone of sufficient size to cause symptoms this catalyst causing the salts of the urine to be precipitated on the aforementioned nidus. Perhaps the unknown substance causes the epithelium to ulcerate thus exposing the plaque to the urine. Really, most microscopic calculi are subepithelial. The formation of symptomatic calculi could be due to the absence of some vitamin like substance or the presence of some other unknown or known substance from the general metabolism of the body or from the diet.

Defense of postulates Postulate 1 is that the concentration of calcium (and related ions) is high in the tissue fluid about the renal tubules. Practically all of the blood supply of the tubular system of the kidney consists of blood which has previously passed through the glomerulus. Cowdry and Shonyo and Mann have made exhaustive studies of the vascular tree of the kidney by the injection corrosion technique and have demonstrated that practically all of the arterial blood reaching the capillaries surrounding the different parts of the tubules is blood which has passed through the glomerulus before it reaches the renal tubules. That there are a few exceptions is not to be denied but that these few exceptions constitute a very small part of the tubular circulation seems also well substantiated. Therefore the *efferent* arterioles of the renal glomerulus carry blood which is soon to pass close to the epithelium of the entire tubular system clear down to the end of the collecting tubules at the tip of the renal papillae.

The function of the glomerulus, it seems well proved by the work of Richards is to filter off by selective osmosis a protein free filtrate of the blood plasma. The constituents of the glomerular filtrate are grouped into three classes (a) high threshold substances which are actively reabsorbed (sodium, po-

tassium calcium magnesium and chlorine) (b) low threshold substances and (c) non threshold substances. For the purposes of this paper we are not interested in the last two classes.

The high threshold substances are in low concentration in the urine and in high concentration in the reabsorbed fluid. This conclusion is drawn from the following reasoning: Richards pipetted off the glomerular filtrate and found that it consisted of a simple protein free filtrate of the blood plasma. As blood passes through the glomerulus, it forms concentrated blood which passes out of the kidney through the efferent arteriole and glomerular filtrate which starts down the tubular system. Two elements of the blood in the first part of the efferent vessels will now be in higher concentration namely the cells and the proteins. The other substances have simply filtered across the osmotic membrane of the glomerulus and remain in the same concentration in the glomerular filtrate as in the blood of the efferent arteriole. The concentration of these ions is therefore unchanged in either. The blood now starts its way down the efferent vessel and passes beside the tubules where the high threshold substances are reabsorbed. Therefore the concentration of these high threshold ions should be high in this blood. Also if the concentration of these easily diffusible ions is the same in tissue fluid as it is in the plasma, the passage of these ions from the glomerular filtrate mentioned previously should increase their concentration in the tissue fluid in the cells and tissues about the tubules as it is reabsorbed. Of course, much of the water is reabsorbed along with the ions but some must go out to form urine. This is estimated to be about 1 cubic centimeter of urine for every 100 cubic centimeters of glomerular filtrate.

Most anatomists and histologists today feel that reabsorption takes place in the convoluted tubules and in the loop of Henle but not down in the tubules of Bellini. Their assumption is largely based on the histologic appearance of the epithelium in the tubules of the collecting type. The epithelium is flattened and undifferentiated in appearance. It does not appear like epithelium elsewhere in

the body which does carry on active reabsorption. However the pyramids contain the lowermost pole of the loop of Henle. As Lowesley and Kirwin stated, "The pyramids are composed of Henle's loops and the straight collecting tubules. We see that reabsorption by the straight collecting tubules is not essential to the completion of the hypothesis and would not be in disagreement with the finding of calcareous plaques well down at the papillary tip. Perhaps the straight tubules do carry on some of the functions of reabsorption."

The question may arise as to the real significance of this supposed high concentration of calcium near the tubules. Some may feel that this concentration is not much higher in actual milligram equivalents than the increase in concentration which occurs with the daily variations of the alkaline tide. Perhaps this is true but it must be pointed out that the concentration of reabsorbed calcium would probably be even higher at this high peak of the day. Perhaps this is exactly the time when the phagocytic cells do absorb the particles of calcium.

Postulate 2 is that phagocytic cells, which seem to be macrophages, occur in abundance about the renal tubules and that macrophages have been shown to have a definite affinity for calcium. A complete review of the subject of macrophages in the kidney is to be found in the work of Kirkman published in 1943. Kirkman also studied the kidneys of rats 25 days of age. The average number of macrophages per square millimeter throughout the pyramid, medulla, and cortex respectively was 53, 93 and 14.

Gersh in 1938 studied the liver and noted that macrophages of the liver as well as those of the spleen had a special affinity for calcium compounds.

Our final interpretation of this study is that in the process of reabsorption of high threshold substances (calcium and related ions) these substances are engulfed by phagocytic cells, which may be macrophages. These ions may first cohere in small masses or "flocks," as shown in Figure 1, before being engulfed by the individual macrophage. Soon the cell contains so much of the metal that it loses its

identity and forms spherical droplets. By cohesive attraction these droplets come together in groups to form a tiny calculus or plaque which we have chosen to call a microscopic calculus. The outlines of the droplets which came together to form the calculus can still be seen about the border of the lesion. Finally all identity of the original droplets is lost in the amorphous plaque. We conclude that this occurs in practically all kidneys. If then these tiny calculi are present in everyone and are found ulcerating through the epithelial membrane of the papillary tip in as high a percentage as is suggested by Randall Vermooten and Rosenow why does not symptomatic renal calculus occur more frequently? We feel that perhaps the inciting factor may lie outside the kidney itself and may be a systemic or a dietary factor.

When this calcareous plaque of the type occurring in almost everyone breaks through the epithelium at the papillary tip it is exposed to the bathing salts of the urine and thus may form a layered concretion or stone which may ultimately break loose and form a symptomatic calculus. That urinary calculi consist predominantly of more than one component is confirmed by Thompson and his associates and by Higgins. This fact lays the foundation for supposing that this microscopic calculus may well serve as the nidus for any type of stone whether it be oxalate urate xanthine cystine carbonate or phosphate when the proper inciting factor comes along.

SUMMARY

A study was made of microscopic calculi as found in the pyramids of 168 kidneys. These included surgically removed kidneys and grossly normal kidneys removed at necropsy. The diseased kidneys were removed for tuberculosis, hydronephrosis, pyelonephritis or stones. Six hundred and twenty nine histologic preparations were made. Originally only one hematoxylin and eosin section of each kidney was studied. Failure to find the microscopic calculi after study of the section from any particular kidney was followed by the cutting and section of further pyramids from the same kidney until the plaques were found or their absence was proved beyond a

reasonable doubt. All of the kidneys were from patients more than 9 years of age. In 50 per cent of the kidneys the plaques were found in the first section studied. In some kidneys as many as 10 histologic preparations were made. The microscopic calculi were found in all of the kidneys.

These microscopic calculi were studied as to morphology and possible histogenesis. It was demonstrated that they were formed by the coalescing of numerous "droplets" of calcareous material. These droplets seemed to be formed by the process of phagocytic ingestion of tiny flecks of black staining material. Attention was directed to the postulate that the concentration of calcium is probably high in the tissue fluid about the renal tubules and to the fact that phagocytic cells occur in abundance about the renal tubules. From these data it was suggested that the calculi were formed by the process of phagocytic ingestion of the calcium which is reabsorbed by the renal tubules.

It was shown that the tiny calculi occur throughout the renal parenchyma. Some were located just under the epithelium at the tip of the papilla and one photomicrograph demonstrated the plaque ulcerating through this epithelium and becoming exposed to the urine of the calices. It is now fairly well accepted that some renal calculi are formed by the process of the salts of the urine being deposited in layers on these plaques. Since a chemically pure calculus is very rare the suggestion is made that perhaps many different types of stone may have this tiny calculus as a nidus.

Since these microscopic calculi occur in practically all people even though only 1/3,333 part of the total pyramidal region of each kidney was cut and examined the question was raised as to why then do not more people form symptomatic stones. The interpretation was suggested that large stones may form only when some inciting factor comes to the kidney which causes the salts to deposit on this eroded nidus plaque. Perhaps this inciting factor substance or catalyst the absence or presence of which is necessary to cause deposition to occur comes from outside the kidney. From the foregoing data the pro-

posal was made that perhaps renal calculus is a systemic or a dietary disease and not a disease of the kidney *per se*

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RESECTION OF THE RECTUM WITH RECONSTRUCTION OF CANAL THROUGH THE PERINEAL APPROACH

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RESECTION of the rectum with reconstruction is presented as an alternative method of dealing with some lesions of the rectum. The abhorrence of a colostomy by some patients when they are told they have a cancer of the rectum is sufficient to decide them against having operation. The surgeon as well may have some qualms regarding the operation of abdominoperineal resection of the rectum for some reason such as early malignancy, small malignant polypi, ulcers which are of doubtful nature, etc. If a smaller operation without colostomy and good prospects of a return of function would suffice, it would place both the surgeon and patient in a happier frame of mind.

The investigations of Davis and Collier have shown that if a carcinoma of rectum or sigmoid has metastasized beyond the pararectal lymph nodes, the next extension may just as well be in the liver or some remote region as in the next lymph node, namely the intermediate or central groups. Therefore it is reasonable to believe that, if there are no metastases beyond the paracolic lymph nodes, adequate excision of the colon including the primary lesion together with the epicolic and paracolic lymph glands offers almost as good a prognosis for cure as does a wider resection including the intermediate and central lymph nodes.

With that belief in mind, it was considered that in certain selected carcinomas of the rectum, which are not fixed to surrounding structures which are not producing obstruction which have produced no obvious metastases, and which are either a cauliflower or an ulcerative type of lesion involving not more than one-third to one-half of the circumference of the rectum, a local resection and reconstruction might have many advantages.

From the Toronto General Hospital and the Department of Surgery, University of Toronto.

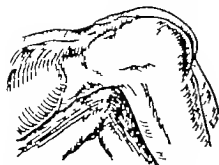
These advantages might be: (1) normal rectal and anal sphincters would be retained with subsequent normal control of the bowels; (2) no colostomy would be required; (3) the shock of operation would be greatly diminished; (4) the danger from infection would be diminished; (5) postoperative complications would be greatly reduced.

A group of patients have been treated in this way and the case reports are presented.

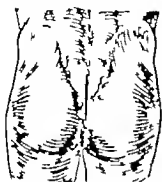
To select the cases suitable for this procedure, it has finally been decided that the ideal case is one in which the growth is above and not involving the sphincters or anal canal mucosa. The growth should be easily palpable through the rectum and for a transanal resection the upper margin of the growth must be palpable with the finger in the rectum and be freely movable on surrounding structures.

OPERATIVE TECHNIQUE

An incision is made from the third spine of the sacrum down to within half an inch of the posterior anal margin. The coccyx, the fifth, and half of the fourth sacral bodies are removed. The pelvic fascia is divided. The dissection is carried around the circumference of the rectum outside the pararectal fascia. When a tape has been placed around the rectum, gentle traction and digital dissection will draw down the upper portion of the rectum and sigmoid. The peritoneum is opened on the anterior surface and sufficient sigmoid is drawn down with which to do a repair with the remaining lower structures of the rectum. When this has been accomplished, the peritoneum is reattached by sutures to the anterior wall of the sigmoid at a new level higher up. The field is then well dusted with sulfathiazole powder and after the field is thoroughly packed off, the rectum is opened well below the growth which is palpable within the lumen. On inspection through this opening, if the growth is not within 1½



Position of patient on table



Line of incision

Fig. 1

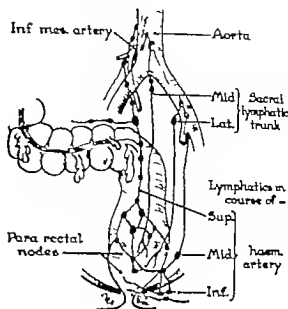


Fig. 2

inches of the site of section, the rectum is divided completely across. The sigmoid is divided across well above the growth and this section of rectum with its surrounding para rectal fascia lymph glands, and lymphatics with the contained growth are removed. It is an easy matter then to do an end-to-end suture between the lower end of the divided sigmoid and the upper end of the remaining rectum. The suture material used has been chromic catgut. A single layer of full thickness sutures has been used. Over the posterior surface some supporting sutures in the fat and surrounding structures have also been applied.

A soft drainage tube is passed down to the cavity below the tip of the sacrum. The levatores ani are closed and if some of the fibers of the sphincters of rectum have been divided these are repaired and the skin closed. Digital examination will now demonstrate the suture line surrounding the rectum and a hard rubber tube $\frac{3}{8}$ inch in diameter is passed through the anal canal through the site of anastomosis, and into the proximal segment. This is stitched to the anal margin. No colostomy is required.

There have been no fatalities in this group. The patients stood the operation without shock and within 2 or 3 days were feeling

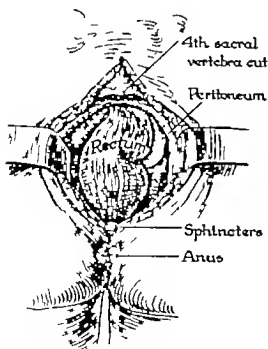


Fig. 3

MURRAY RESECTION OF RECTUM

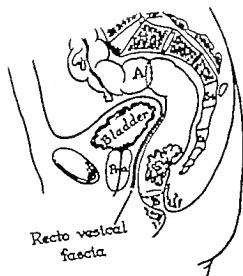


Fig. 4.

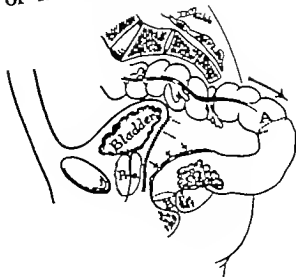


Fig. 5

CASE REPORTS

quite normal. There has been no peritonitis, or other serious complications. All the patients have had control of the rectum. There has been serous discharge from the sacral drainage in all and in some there has been suppuration with purulent discharge but in most this has healed. There has been no osteomyelitis of the sacrum. There has been no stenosis. In 1 case in which the growth was slightly higher up so that its upper margin could be scarcely felt, there was slightly more tension than is advisable at the suture line. In this case the patient developed a fecal fistula which discharged through the site of the sacral drainage tube for 10 days. It then closed spontaneously without further complications. The patient made an excellent recovery and has normal function of the rectum. In another patient in whom there was a larger growth requiring resection of a greater length of rectum and which probably was not suitable for this procedure, there was a separation of the suture line around half of the circumference of the rectum. A fecal fistula developed and has persisted for 4 months through which a small quantity of feces discharged daily.

What the end may be is not known and a colostomy may be necessary before the condition is cleared up. In half the cases, a temporary fecal fistula developed but this healed spontaneously with 1 exception within 3 weeks. In none of the cases was a colostomy performed.

CASE 1 O M female aged 65 years, was admitted to the hospital March 9 1942. For 3 months this patient had had rectal bleeding. On digital examination her doctor found a small mass $1\frac{3}{4}$ inch in diameter, 3 inches within the rectum. Biopsy showed this to be adenocarcinoma. Three inches of rectum, proximal and distal including the growth were excised and an end-to-end repair carried out. The specimen showed no invasion of regional lymph nodes. The patient was discharged on March 24, 1942. The incision had healed. There was normal control of the rectal sphincter and colon function was normal in all respects.

This patient is still well without signs of recurrence and with normal function now 3 years following the operation.

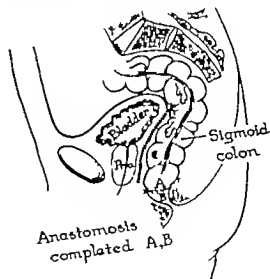


Fig. 6.

CASE 2 A H. aged 35 years was admitted to the hospital on March 22, 1942. The patient had typical symptoms of carcinoma of rectum which were demonstrated on digital examination. He had lost 30 pounds in weight. There was marked secondary anemia with a hemoglobin of 54 per cent. He was sleeping poorly and was in constant distress from the rectal lesion. A large mass surrounding two-thirds of the circumference of the rectum, ulcerated in its center was easily palpable. It extended downward beneath the mucosa of the anal canal on the posterolateral aspect. The mass was not fixed to surrounding tissues.

Through a sacral approach the rectum was exposed. It was demonstrated on palpation that the mass was extending in the submucosa deep to the external sphincter of rectum. The question arose whether an adequate resection could be carried out locally or whether an abdominoperineal resection would improve the prospects of cure. It was felt, however, with the possible muscle invasion that the prospects for cure under any condition were not good. A local resection was carried out when the posterior half of the rectal and anal sphincters together with rectum and growth were removed. An area of anal mucosa 2 inches by 1 inch was left on the anterior wall. The anal canal was reconstructed and the external sphincter reconstructed around this. The lower end of the sigmoid was anastomosed to the end of anal canal. Microscopic studies demonstrated this growth to be an adenocarcinoma with invasion of regional lymph nodes. The patient made an uninterrupted recovery and left hospital with the incision healed in 3 weeks. There was normal control of the anal and rectal sphincters and the patient had normal colon function.

The patient's general health improved and he returned to work. He returned in 5 months complaining of pain in the region of the left hip. X-ray films at that time showed an area of rarefaction in the femur which had the appearance of a metastatic growth in bone. While the patient continued at work for a year this growth in the femur enlarged until finally there was a pathological fracture. The patient finally succumbed to generalised metastases of peritoneal cavity and skeleton. There was a small local recurrence of the growth in the anal region during the last few months. With local radiation this was controlled and caused no further symptoms.

It is doubtful if a more radical operation would have made any difference to the incidence of metastases as these almost certainly were present before the operation.

CASE 3 J B. aged 70 years, was admitted to the hospital in August 1941. The patient had a malignant polyp 2½ inches in diameter on the posterior wall of the rectum 2 inches from the anal margin.

Through a posterior approach the involved segment of rectum with 2 inches distally and 3 inches proximally was excised together with the

lymphatics and lymph glands. Sulfathiazole was applied and a drainage tube inserted. The skin incision was healed in 10 days. There was no fistula. The suture line in the rectum healed completely without stenosis.

The patient has normal control of the bowel and rectum. Analysis of the specimen showed it to be polypoid adenocarcinoma. There were no metastases in the regional lymph glands removed.

CASE 4 C S. aged 58 years, was admitted to the hospital on September 4, 1942. This patient had an ulcerating carcinoma in the anterior wall of the rectum beginning 1½ inches above the sphincter region. The growth was 2½ inches in length by 1½ inches in width. It moved fairly freely over the vaginal wall anteriorly.

Through the posterior approach the mass with 3 inches of the rectum proximally and 3 inches distally was removed together with the surrounding fat, fascia, lymphatics, and lymph glands. An end-to-end suture was carried out without difficulty. The suture line was completely healed within 3 weeks. There was no fistula. The patient had normal control of bowel and rectum. There was no stenosis on examination. Dissection of the specimen showed this to be an adenocarcinoma with invasion of the epiploic but not of the more remote lymph nodes.

Now 2½ years following the operation there is no evidence of recurrence either locally or generally.

CASE 5 E. T. O. aged 62 years, was admitted to the hospital on October 18, 1943. A malignant polyp 2½ inches in diameter attached to the anterior wall of the rectum was identified. Biopsy described this as a polypoid carcinoma.

Through a posterior approach a length of 6 inches of rectum and lower sigmoid was removed with the surrounding lymphatics and lymph glands with the growth in the center. An end-to-end suture was carried out without difficulty. A drainage tube was passed down to this area. The suture line was completely healed in 2½ weeks. There was no fistula. The patient had normal control of the rectum and bowels. The suture line was healed satisfactorily. There was no stenosis. There was no evidence of recurrence either locally or generally 1½ years following the operation. Sections of the specimen showed no invasion of regional lymph glands.

CASE 6 E. B. aged 72 years, was admitted to the hospital on December 13, 1943. The patient had an adenocarcinomatous ulcer in the posterior wall of the rectum 4 inches from the anal margin. There was no evidence of metastases.

Through a posterior approach the involved segment of rectum with 3 inches of colon proximally and 2 inches distally was removed with surrounding fat, lymphatics, and glands. This was at the upper

margin of the point at which the resection by this method could be carried out. However a satisfactory end-to-end repair was completed although there was somewhat more tension at the suture line than was desirable. The patient developed a fecal fistula which lasted for 10 days at which time it healed. The skin incision was completely healed in 3 weeks. The patient had normal control of bowel and rectum. There was no stenosis and no evidence of new growth 1 year following the operation. Anal vs. showed this to be adenocarcinoma involving the muscular coats and with no invasion of regional lymph glands.

CASE 7. A. D., aged 60 years was admitted to the hospital on January 7, 1944. This patient had symptoms typical of carcinoma in the rectum. On examination there was an ulcerated area on the posterior wall, the growth measuring 3.5 centimeters in diameter. It was freely movable and it was thought that it was suitable for a local resection.

Through a posterior approach the rectum with the pararectal fascia, lymphatics and adjacent lymph glands was dissected free. Seven inches of the lower sigmoid and rectum was removed with the malignant mass in its center. An end-to-end suture was carried out without difficulty giving a satisfactory repair. Sections of the specimen showed it to be an adenocarcinoma with metastases in the pararectal lymphatics but none in the immediate lymph glands which were removed. The incision was healed completely in 2 weeks. There was no fistula.

To date there is no evidence of recurrence. The patient has normal function of the bowels and control of the rectum.

CASE 8. A. O. G. aged 52 years was admitted to the hospital on June 7, 1944. The patient had a malignant ulcer on the posterior wall of the rectum $4\frac{1}{2}$ inches from the anal margin.

Through a posterior approach the involved segment with $2\frac{1}{2}$ inches proximal and $2\frac{1}{2}$ inches distal was removed. An end-to-end suture was carried out satisfactorily. The posterior incision was healed completely in 2 weeks. There was no evidence of fistula. The bowels and rectum were functioning normally. Analysis of the specimen showed this to be only a chronic ulcer which differed from the original hypothesis. There was no evidence of malignancy. There was no primary or invasion in the regional lymph glands.

CASE 9. A. N. aged 58 years, was admitted to the hospital on August 11, 1944. The patient had an ulcerated carcinoma in the posterior wall of the rectum 3 inches above the anal margin. It was lightly attached to surrounding structures, especially on the right posterolateral quadrant. There was no evidence of metastases elsewhere.

Through a posterior approach the involved segment of the growth with 2 inches proximally and 3 inches distally was removed. A satisfactory end-to-end repair was carried out. However there was more tension in the suture line in this case than was

desirable. Sulfathiazole was applied and a drainage tube was passed down to the site. The patient developed a fecal fistula on the eighth day which discharged a moderate amount of feces through the upper end of the incision. In the meantime the bowels were functioning naturally. On palpation through the rectum the posterior half of the suture line had separated leaving a gap of $1\frac{1}{2}$ inches between these margins. The fistula continued to discharge small quantities of feces. Otherwise there was normal control of the bowels.

Now 7 months following the operation there is still a small fecal fistula over which the patient wears a small layer of gauze. Otherwise the bowels are functioning normally. The patient's general health is excellent. There is no evidence of recurrence of the growth. Analysis of the specimen showed this to be adenocarcinoma. The glands removed from the perirectal area showed only chronic lymphadenitis with no evidence of new growth.

CASE 10. M. M. aged 62 years, was admitted to the hospital on August 11, 1944. The patient had a carcinomatous ulcer $2\frac{1}{2}$ inches in diameter in the posterior wall of the rectum 3 inches above the anal margin. It was fairly freely movable but still it was felt that there was slight attachment to the surrounding structures, especially on the left posterolateral region. There were no evidences of metastases elsewhere.

Through a posterior approach the involved segment of rectum with 3 inches proximally and 2 inches distally was removed. The surrounding fat, lymphatics and lymph glands were removed. A satisfactory end-to-end repair was carried out. Sulfathiazole was used as in all these operations, and a drainage tube was passed down to the site. The incision was completely healed in $2\frac{1}{2}$ weeks. There was no fistula at any time. The patient had normal control of bowel and rectum. There was no stenosis on digital examination. The analysis showed this to be an adenocarcinoma. The regional lymph glands in the pararectal position showed no invasion by carcinoma.

CASE 11. T. F. aged 64 years was admitted to the hospital in August 1944. This patient had a polypoid carcinoma on the posterior wall of the rectum 4 inches from the anal margin. There was no evidence of fixation of the growth.

Through a posterior approach the affected segment with the growth with $3\frac{1}{2}$ inches proximally and $2\frac{1}{2}$ inches distally was removed. A satisfactory end-to-end repair was carried out. At no time was there a fistula. The incision was healed in 10 days. The patient had normal control of bowel and rectum. There was no stenosis. The analysis of the specimen showed this to be an adenocarcinoma. There was no

evidence of invasion of regional lymph glands.

CASE 12. M. T. aged 21 years, was admitted to the hospital on October 10, 1944. The patient had symptoms leading to the diagnosis of rectal polyp. On biopsy this was shown to be a malignant polyp on the posterior wall of the rectum within an inch of the anal mucosa. This growth was treated in the radiology department by deep therapy and interstitial radium application. The lesion appeared to be cured by this procedure. However, it left the patient with a radiation ulcer $1\frac{3}{4}$ inches long and $\frac{3}{4}$ inch wide in the posterior wall of the rectum extending down into the region of the sphincter posteriorly. As this had persisted for a year and a half and was causing a great deal of discomfort and disability it was suggested that an excision of this area be carried out.

On October 10, 1944 the area was exposed through a posterior incision. The circumference of the rectum was defined and the area of ulceration localized. The posterior two-thirds of the circumference of the rectum was excised by an elliptical incision including the ulcer. This was repaired with a double line of sutures. A drainage tube was passed down to this site after applying sulfathiazole crystals. Healing was quite satisfactory and was completely closed in 3 $\frac{1}{2}$ weeks. The symptoms were entirely relieved. On rectal examination the suture line was palpable. It was well healed.

CASE 13. I. W. aged 55 years was admitted to the hospital on November 13, 1944. This patient was demonstrated 6 months previously to have carcinoma of the rectum. It was adherent to surrounding structures. It was treated by the radiologists with deep therapy and with interstitial radium. The growth diminished in size leaving only a scarred area causing fairly severe stenosis 3 inches above the anal margin. He was seen in consultation with the radiologists when it was decided to make an attempt to resect this segment of the invaded rectum.

Through a posterior approach it was demonstrated that there was much more scarring in the tissue surrounding the rectum than was found under ordinary conditions, probably as a result of the radiation therapy. However it was not difficult to define a plane through which a dissection could be carried out surrounding the rectum, pararectal fascia, lymphatics and adjacent lymph nodes. The involved segment of rectum with $2\frac{3}{4}$ inches proximally and 1 inch distally was removed. An end-to-end suture was carried out without difficulty. The incision was somewhat slower in healing. This might have been the result of the previous radiation. However it was healed satisfactorily in 4 $\frac{1}{2}$ weeks. A fistula discharging only a small quantity of feces developed for a period of 3 weeks. This finally closed. The patient had normal control of bowel and rectum and there were no symptoms. The analysis of the specimen removed showed that there were still carcinoma cells in the region imbedded in massive scar tissue. The lymph glands removed with the rectum showed no invasion by carcinoma.

CASE 14. G. T. B. was admitted to the hospital in March 1945. This patient clinically had carcinoma palpable with the tip of the finger on the anterior wall of the rectum. It was felt to be moderately large and probably not very suitable for a perineal excision. However as the patient was firmly decided against having a colostomy it was decided to attempt removal by the perineal approach.

At the operation it was found that the mass was fairly large, although there was no extension to lymph glands beyond the regional group which could be identified at operation. The mass was removed. The repair was carried out without much tension. A tube was passed through the anastomosis and post sacral drainage provided. The patient stood the operation very well. The incision healed without infection. There was a slight fecal discharge for about 1 week. By the end of 3 $\frac{1}{2}$ weeks the incision and the fistula were completely healed. The patient had complete control of the sphincter at that time. There was no stenosis present at the suture line and the patient made a satisfactory recovery.

The pathologist's analysis of the specimen showed this to be an adenocarcinoma of colon. The regional lymph glands showed no invasion by secondary growth. They showed only chronic lymphadenitis.

CASE 15. C. C. aged 64 years, was admitted to the hospital in May 1945. In 1931 this patient had had an operation for internal hemorrhoids at another hospital. A polypoid mass $1\frac{3}{4}$ by $1\frac{1}{4}$ inches was removed. On section this was demonstrated by the pathologist at that time to be adenocarcinoma. The patient was quite free from symptoms until January 1945, at which time he began to have symptoms typical of carcinoma of rectum. On examination there was a polypoid mass which was situated in a position on the anterior and left lateral wall of the rectum where it could be palpated with the finger freely but its upper margin could not be felt easily. There was one unpleasant symptom which was irritation of the bladder making one doubt if this growth were resectable. It was decided to attempt an exploration through the perineum being prepared to continue to do an abdominal stage if the growth were not removable through the former route. It was found that the growth could be quite freely detached from all the surrounding structures. It was brought down into the post sacral incision without difficulty. It was resected and a satisfactory end-to-end repair was carried out without colostomy. The patient made an untroubled recovery. There was a fistula present for about 3 weeks. This healed and left the patient with a normal functioning rectum without any stenosis.

The pathologist's analysis of the specimen showed an adenocarcinoma of fairly large proportions of the cauliflower type but no invasion of regional lymph glands.

CONCLUSIONS

1 In early carcinoma of rectum extending as low as the anal canal, resection with reconstruction and preservation of the sphincters without colostomy is a satisfactory procedure

2 The operation is attended by very little shock or hemorrhage. The patients all made a satisfactory recovery. There were no deaths in this group reported

3 This report is based on 15 cases. With the exception of 2 cases all infection in the perineal wound had healed and signs of fistula had disappeared within 3 weeks. In one of the remaining two the fistula closed in 5 weeks. In one other it was present at 4 months. What the end result in this will be is not yet determined. The prospects for cure in this group seemed fairly satisfactory. This was based on the pathologist's evidence that there was no extension of the growth beyond the local lesion with possible infiltration of the surrounding muscular wall. There was 1

lymph gland invasion. All the patients had normal control of sphincters. There was no stenosis at the site of anastomosis. The rectum function was normal in all respects

4 One patient has died from recurrent growth with metastases in the peritoneum and bone causing a fracture of femur. This case Case 2 in this series was an unsuitable case as it was a very advanced carcinoma with invasion of the anal mucosa and surrounding structures. It is quite obvious however that any other type of procedure would not have offered any better prospects for cure

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STUDIES ON EXOPHTHALMOS PRODUCED BY THYROTROPIC HORMONE

I A Study of Exophthalmos Produced by Various Thyrotropic Hormones and the Influence of the Testes on the Exophthalmos

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MANY investigators have demonstrated that thyrotropic hormone from the anterior pituitary may be used to produce exophthalmos in guinea pigs. Many of the observers have found that the exophthalmos was produced more easily in thyroidectomized than in intact animals. The problem of obtaining accurate measurements of the prominence of the eyes in many of these experiments has been a major obstacle. Two improved methods for measuring minute changes in the prominence of the eyes have been devised and described elsewhere (6).

Using these two methods of measuring exophthalmos, a rather extensive investigation has been undertaken, first, to compare the changes in the prominence of the eyes induced by various preparations of thyrotropic hormone and second, to correlate the exophthalmos with the various tissue changes which occurred as a result of administration of the hormone. This report not only describes the effects induced by the administration of various anterior pituitary preparations on the prominence of the eyes in guinea pigs but also takes into consideration the influence of the testes on the development of exophthalmos.

The literature dealing with the relation of the gonads to exophthalmos is confusing because of the variety of ways which have been employed to produce exophthalmos. Marine (16-18) and Marine and Rosen (20) reported that exophthalmos did not develop in gonadectomized puberal rabbits as it did in normal animals when thyroid insufficiency was pro-

duced by thyroidectomy or methyl cyanide. They (17-21) found that the production of permanent cryptorchism with the associated degeneration and absorption of germinal epithelium of the testes did not inhibit this type of exophthalmos in rabbits. Spontaneously exophthalmic guinea pigs did not show a regression of their exophthalmos after gonadectomy. They reported (21) that these types of exophthalmos could be instantly converted to enophthalmos by cervical sympathectomy. This fact would serve to distinguish this type of exophthalmos from that produced by thyrotropic hormone, which is not influenced by cervical sympathectomy (32-33-36). No changes in body weight of the animals resulting from surgical procedures were described.

Smelser (33) reporting studies on exophthalmos induced by thyrotropic hormone referred to the fact that some of his male and female animals were gonadectomized. Special reference, however to the results in these animals was not included. Smelser (38) reported that oophorectomy had no effect on the changes that were induced by thyrotropic hormone in the Harderian glands of guinea pigs.

Marine (17-18) reported that sex hormones such as testosterone propionate, androsterone and dehydroandrosterone caused a return of the exophthalmos previously abolished by orchectomy.

I described in an earlier publication (6) the increase in the prominence of the eyes after thyroidectomy in normal guinea pigs. In the preliminary experiments of this investigation, it was found that after thyroidectomy had been performed, preparatory to the administration of thyrotropic hormone, the eyes increased in prominence. That series of observa-

Abklyment of thesis submitted by Dr. Dobyns to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Ph.D. in Surgery. The work on which the thesis was based was done in the Division of Experimental Medicine of the Mayo Foundation in the laboratory of Dr. George M. Huggins.

Dr. Dobyns, Fellow in Surgery Mayo Foundation.

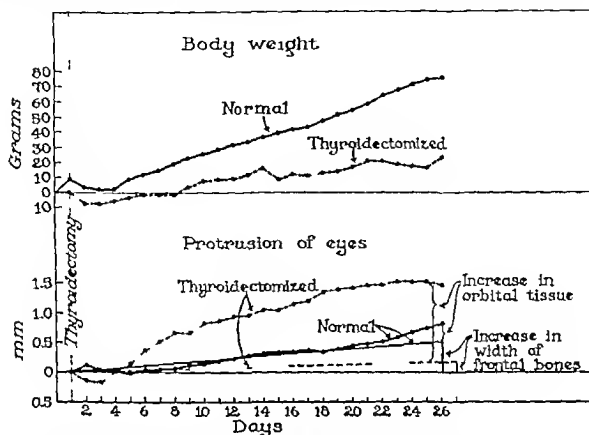


Fig. 1. Changes of the prominence of the eyes resulting from thyroidectomy in the normal guinea pig. The increase in the width of the frontal bones, as illustrated in the lower right, is represented by the same scale as the measurements dealing with the eyes.

tions on the effects of thyroidectomy alone served as a control for the experiments to be described dealing with the effects of thyrotropic hormone.

The control experiment is very briefly reviewed and illustrated. Seventeen growing male guinea pigs weighing from 322 to 500 grams were used. Thirteen were thyroidectomized and 4 served as controls. The intercorneal distance and body weight of these animals were determined at intervals of from 1 to 3 days for 14 to 26 days. It can be seen in Figure 1 that thyroidectomy alone causes some increases of the prominence of the eyes.

EXPERIMENTAL METHOD

The following anterior pituitary products were used in these experiments (1) antuitrin T prepared for clinical investigation (2) purified thyrotropic factor prepared for clinical investigation (3) a crude thyrotropic preparation from the anterior pituitary of swine prepared especially for this study and known to contain small amounts of other known im-

purities and (4) the specific metabolic principle of the pituitary which was prepared according to the specifications of Collip and his co-workers (3, 5).

Normal guinea pigs weighing between 300 and 400 grams were selected from our Institutional stock colony. Animals showing any spontaneous exophthalmos or retardation of growth were avoided. Since color affords greater facility in obtaining accurate measurements (6) animals which possessed white cream or buff color about the face, which possessed a darkly pigmented face, were selected for study. The animals were maintained on standard laboratory ration consisting of oats, alfalfa hay, beets and lettuce or green grass as the season permitted.

The intercorneal distance was measured three times with each of the two eyes at intervals of 1 to 3 days. The average of 6 determinations represented the protrusion of the eyes for that particular day. Body weight was likewise recorded. The animals were thyroidectomized and, after varying

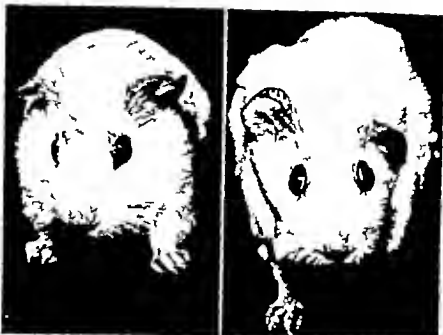


Fig. The gross appearance of exophthalmos produced by antuitrin T (Parke, Davis and Co.) a, left, Normal guinea pig; b, thyroidectomized guinea pig treated with antuitrin T.

were given one of the thyrotropic preparations at daily intervals. Approximately half of the animals in some of the groups observed were not only thyroidectomized but also orchiectomized.

At the conclusion of these observations, the animals were killed and the tissues were studied grossly and microscopically with a variety of staining techniques. The results of the tissue observations will form the basis for subsequent reports.

A. THE EFFECT OF ANTUITRIN T ON THE PROMINENCE OF THE EYES IN THE GUINEA PIG

Method. Data assembled from 19 animals comprise the basis of the report on this thyrotropic product. Eight animals were thyroidectomized. Seven were thyroidectomized and orchiectomized. Four were normal and served as controls. Five to 11 days were allowed to elapse between the operation and the beginning of administration of antuitrin T except that in 2 cases, in which the animals were both thyroidectomized and orchiectomized 31 days elapsed before the administration of the hormone was begun. The animals received by either the intraperitoneal or the

subcutaneous route, 0.5 cubic centimeter (1.0 c.c. in 1 case) of antuitrin T containing 25 Junkmann-Schoeller units¹ each day for 3 to 32 days.

Antuitrin T when given in this amount (0.5 c.c. daily) was found to produce a rather toxic effect on many of the animals. For this reason its administration was on rare occasions discontinued for a day in order to permit the animal to regain its strength.

Because the literature contains controversial opinions concerning the relations of vitamin C to the effects caused by thyrotropic hormone and because these animals were studied during the winter months, when guinea pigs are often on the border line of scurvy, some data were assembled on the effects of giving vitamin C. Accordingly 5 animals were given 2.5 milligrams and 2 were given 5 milligrams of crystalline ascorbic acid daily intraperitoneally during the time they received antuitrin T. Ascorbic acid however failed to influence in any way the exophthalmos that developed.

¹That amount of extract which when injected daily for 3 days into guinea pigs weighing 200 to 300 grams causes a perceptible hypertrophy of the epithelium and disappearance of colloid in the thyroid of 3 animals (11, 1).

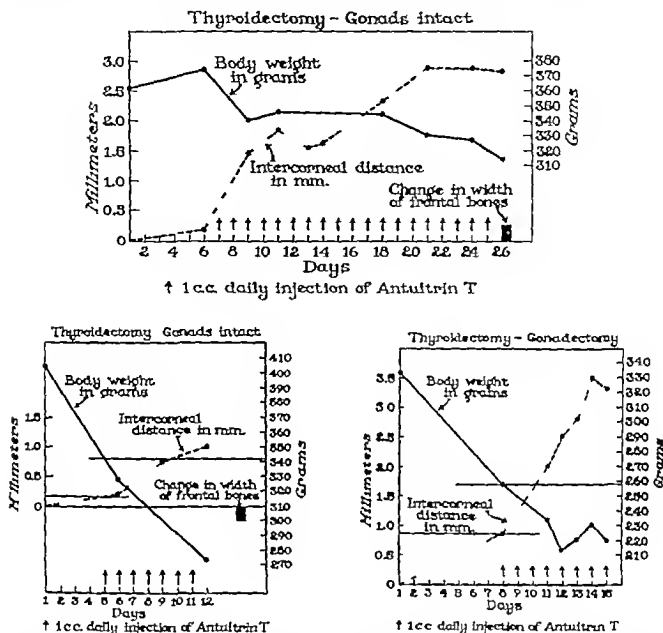


Fig. 3. The changes in body weight and intercorneal distance in animals receiving antuitrin T illustrated by the records of representative animals. Arrows indicate daily injection of antuitrin T a, above, Thyroidectomy—gonads intact—slight loss of body weight b left, below thyroid-

ectomy—gonads intact—extreme loss of body weight. (Extremes in influence of body weight are shown by a and b. Influence of loss of body weight on intercorneal distance is easily seen. Compare with Fig. 4 showing loss of body weight by fasting.) c, Thyroidectomy and gonadectomy

Results Within 30 minutes to 1 hour after the injection of antuitrin T many of the animals appeared ill. Their state was characterized by inactivity and a ruffled coat. In 12 to 24 hours some animals demonstrated stiffness of the limbs which in some instances almost amounted to a state of cataplexis.

Definite gross exophthalmos occurred in most of the animals in spite of considerable loss of weight (Fig. 2). The greatest actual increase in intercorneal distance was 3.5 mill-

imeters. Although thyroidectomy *per se* resulted in a protrusion of the eyes, the increase produced by antuitrin T was superimposed in a much more acute and striking fashion (Compare Fig. 1 with Fig. 3a and c.) With both of the methods of measurement employed there was obtained in most instances an unequivocal increase of intercorneal distance within 24 hours after injection.

The removal of the testes had no inhibitory effect on the development of exophthalmos

TABLE I.—EXOPTHALMOS OF ANIMALS
RECEIVING ANTUITRIN T

	Days of treatment	Weight loss, gm	Observed exophthalmos, mm	Correction for weight loss, mm	Corrected exophthalmos, mm
Thyroidectomized	1	-50	83	+ 00	83
	5	-55	5	+ 25	30
	7 ^a	-77	-0 30	+ 30	00
	9	-47	20	+0 75	1 5
	7	- 33	00	+ 00	0 00
		-30	5	+ 00	1 5
	9	+6	75		75
	7	-100	30	+ 75	5
Gonadectomized and thyroidectomized	9	- 03	1 5	+0 75	00
	6	-30	03	+0 30	1
	24	-14	00	+0 5	0 5
	36	-30	75	+0 75	30
	14	-28	1 30	+0 75	4 5
	15	-30	75	+0 30	5
Intact	1	-26	-0 5	+0 75	30
		- 7	00	+0 75	75
		-28	26	+	30
	37	-124	-0 28	+ 30	
	37	-0	30	+0 25	83

^aTreatment given on 7 of 8 days
(Treatment given on 8 of 9 days)

(Fig. 3c and Table I) As a matter of fact the two most striking degrees of exophthalmos occurred in animals which had been orchectomized.

Control experiments It is common knowledge that when an animal loses weight there is a recession of the globes of the eyes into the orbits. Because some of these animals lost rather striking amounts of body weight (Fig. 3b) further observations on the relation of changes in the body weight to changes in the prominence of the eyes were indicated. Furthermore, it was necessary to know whether the solvent in which the active principle of antuitrin T was dissolved or the preservative present in the solution could cause exophthalmos or the toxic effects observed in these animals.

When the solvent¹ including the preservative but without the pituitary ingredient,

was given in comparable amounts to 6 control animals there were no increases in the intercorneal distances nor were there evidences of a toxic influence, such as hitherto observed.

In a second control experiment the changes in the intercorneal distance were studied in animals whose body weights were decreased by fasting. Food was withheld from 5 animals comparable to those used in the preceding experiment but drinking water was provided *ad libitum*. These animals lost from 30 to 40 per cent of their body weight in 10 to 16 days. Their body weights and the changes in their intercorneal distances were recorded at frequent intervals. As the retrobulbar tissue became depleted concurrently with atrophy of comparable tissue elsewhere in the body the globes of the eyes receded into the orbit. The correlation between the regression in the prominence of the eyes and the decrease in body weight is illustrated by a representative animal of this group (Fig. 4). This illustration shows that for the first 40 grams of loss in body weight in an animal of this size there was a decrease in intercorneal distance equal to the amount *a*. For an additional loss of 40 grams of body weight an added regression equal to the distance *b* resulted and so on.

On the basis of these correlations between decreases in weights of body and regressions of eyes, correction factors have been devised for use in the interpretation of the eye measurements assembled from animals which had been treated with antuitrin T and had lost weight. An animal which lost considerable weight when antuitrin T was administered is illustrated (Fig. 3b). Although the prominence of the eyes in this animal (Fig. 3b) increased relatively little, there was an exophthalmos-producing mechanism which prevented a regression of its eyes such as occurred in the fasting animal which lost a comparable amount of weight (Fig. 4). With the application of the correction factors it has been possible to evaluate the exophthalmos-producing effect of antuitrin T more accurately thus correcting for the loss of tissue volume in the orbit associated with loss of weight. Table I has been compiled in this way.

It will be seen that 3 of the 19 animals sustained a slight decrease of the prominence of

¹The information necessary for the preparation of the solvent for antuitrin T was obtained from the manufacturer.

the eyes while receiving antuitrin T. The decrease, however, was not of the magnitude of that sustained by a fasting animal losing the same amount of weight. On the other hand, some animals showed considerable increase in the prominence of the eyes in spite of considerable loss of body weight. After a correction of the exophthalmos based on the loss of body weight it can be seen (Table I) that the exophthalmos produced in gonadectomized animals was as great as that in animals with testes intact. Except for 2 animals which were orchectomized and in which more striking exophthalmos developed, the 2 groups of animals were essentially equal in this regard.

In the 4 intact animals which received antuitrin T, there did not develop a degree of exophthalmos comparable to that of the thyroidectomized animals even though correction for losses of body weight was made. Thus difference may be explained at least in part by the data derived from control experiments which illustrated how thyroidectomy alone produced some increase of the prominence of the eyes.

Comment The importance of accurately correlating changes in body weight with changes in the prominence of the eyes is clearly illustrated. Loeh and Friedman and also Smelser (32-34) recognized a regression of exophthalmos in animals which lost considerable weight. It is common knowledge that exogenous origin, will cause a loss of body weight. Whether of endogenous or of exogenous origin, whether of thyroidectomized animals or of animals which lost weight by other means, many authors have reported that exophthalmos was produced less readily in intact animals than in thyroidectomized animals. Absence of the thyroid presumably precludes the possibility of thyrotoxicosis developing when thyrotropic hormone is given. It has been pointed out by Marine (18) in intact animals and Smelser (34) in thyroidectomized animals that thyroxine when administered to animals simultaneously with thyrotropic hormone diminishes the exophthalmos. It has also been shown that after the administration of thyrotropic hormone to normal animals for several weeks the incidence of exophthalmos increases considerably. Friedgood (8) has shown that this latent exophthalmos develops later when the thyroid of the animal has become refrac-

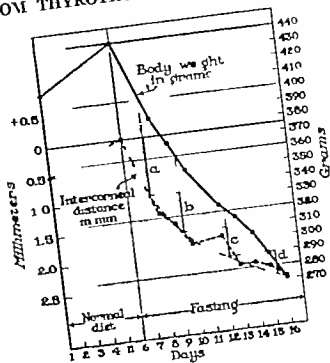


Fig. 4. The changes of body weight and intercorneal distance in a fasted animal. *a*, The decrease in the prominence of the eyes coincident with the first 40 gram loss of body weight. *b*, The decrease in the prominence of the eyes coincident with the second 40 gram loss of body weight. *c*, The decrease in the prominence of the eyes coincident with the third 40 gram loss of body weight. *d*, The decrease in the prominence of the eyes coincident with the fourth 40 gram loss of body weight. (Compare with Fig. 3a, b and c.)

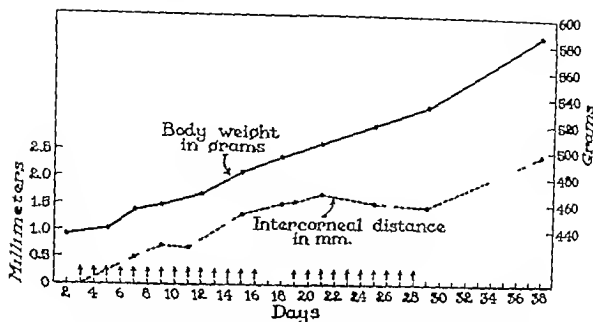
tory to the influence of thyrotropic hormone. When this phase is reached the basal metabolic rate falls, evidence of thyrotoxicosis disappears and the animal usually gains weight. At this time the prominence of the eyes would be expected to increase.

These experiments reported here which correlate fluctuation of body weight with changes in the prominence of the eyes contribute to our understanding of some of the differences in interpretation of exophthalmos which have appeared in the literature.

B THE EFFECT OF A PURIFIED THYROTROPIC FACTOR (ARMOUR¹) ON THE PROMINENCE OF THE EYES IN GUINEA PIGS

Method This product was administered in 0.5 and in 1 cubic centimeter (in one instance 2 c.c.) daily amounts to 8 male guinea pigs. Six of these animals had been thyroidectomized.

¹ Assayed and found to contain 5 Rowlands-Parkes units per cubic centimeter according to the manufacturer's method. One Rowlands-Parkes unit is that amount which when injected daily for 5 days into a 100 gram female guinea pig will cause the thyroid to double its weight or attain a weight of 66 milligrams (8).



↑ = 1 cc. daily dosage purified thyrotropic factor

Fig. 5. Changes of intercorneal distance and body weight in a thyroidectomized guinea pig receiving purified thyrotropic hormone. The increase of intercorneal distance is comparable to the increase caused by thyroidectomy alone. (Compare with Fig. 1)

mixed. One of these had also been orchectomized. Two others were subtotally thyroidectomized. The administration of this so called purified thyrotropic factor was begun 2 to 4 days after thyroidectomy except for one animal, which began to receive 2 cubic centimeters of the preparation on the 16th post

operative day. All animals received the product for periods ranging from 7 to 39 days.

Results In contrast to antultrin T this "purified" thyrotropic product in the amount given did not cause a loss of body weight nor did it cause the toxic manifestations previously described. Furthermore it did not produce very definite evidence of exophthalmos (Fig. 5). It would appear that the increase of the prominence of the eyes in these animals occurred in a manner comparable to that seen in growing animals which had been thyroidectomized alone (compare Fig. 1 and Fig. 5). In view of the weight which was gained, the increase of intercorneal distance certainly is not striking (Table II). Two animals, however obtained an increase which was out of proportion to the changes in body weight. Demonstrable differences in the effects due to the different doses administered were not evident for one animal which received 2 cubic centimeters (containing 10 Rowlands-Parkes units) daily described no appreciable change in the intercorneal distance, further evidence that this pituitary thyrotropic preparation in the amounts given had relatively little or no exophthalmos-producing effect.

TABLE II.—CHANGES IN THE PROMINENCE OF THE EYES INDUCED BY PURIFIED THYROTROPIC HORMONE

Operation	Treatment		Increase of intercorneal distance, mm.	Change of body weight, gm.
	Days	Amount, cc.		
T*	35	60	30	+92
T	20	30	30	+77
T	24	60	30	+8
T+G*		30	35	+85
T	14†	30	63	-97
Subt. T*	36	30	15	+123
Subt. T	22	30	66	+45
T	7	60	23	+40

*T = thyroidectomy; T + G = thyroidectomy and gonadectomy;
 Subt. T = subtotal thyroidectomy.
 †Treatment given on 4 of 16 days.

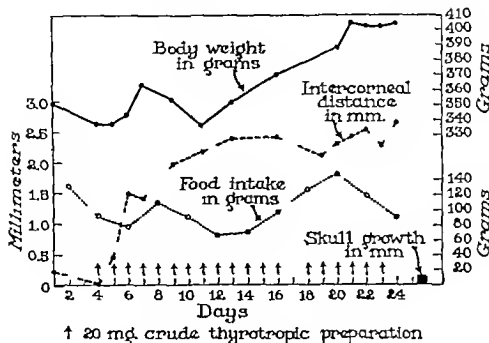


Fig. 6. Changes of intercorneal distance, body weight and food consumption in a thyroidectomized animal receiving crude pituitary thyrotropic factor. Thyroidectomy was performed 3 days before administration of the crude thyrotropic preparation was begun. Arrows indicate injection of 20 milligrams of the product.

C. THE EFFECT OF A CRUDE PITUITARY THYROTROPIC PREPARATION¹ ON THE PROMINENCE OF THE EYES IN GUINEA PIGS

Because the 'purified' thyrotropic factor caused hyperplasia of the epithelium of the thyroid but did not induce appreciable exophthalmos, the question arose whether in the process of 'purification' the product may have lost its exophthalmos-producing quality. Some investigators have suggested the possibility that the anterior pituitary may contain two factors, one of which causes exophthalmos and the other thyroid hyperplasia.

A crude thyrotropic preparation was made from the anterior pituitaries of swine in a manner comparable to that employed in preparing the 'purified' thyrotropic factor except for the efforts at purification. This product was reported by the manufacturer to contain some adrenotropic and some gonadotropic principles in very minute quantities.

Method. Ten animals were used in this study. Six of the 10 animals were thyroidectomized and 4 were thyroidectomized and

orchiectomized. Three to 10 days after thyroidectomy daily administration of 20 milligrams of the powdered crude thyrotropic preparation suspended in water was begun. After 6 days of this administration the amount was increased to 40 milligrams in half of the animals. This however caused very little if any added effect on the exophthalmos that already had been produced by the smaller amount.

Before this crude thyrotropic product was given 2 of the animals received each day for 5 days, 1 cubic centimeter of the so called purified thyrotropic factor bearing the same lot number as that used in the preceding experiment. Since these injections proved ineffective in producing exophthalmos the administration of the crude preparation in the same unit dose was begun. The changes in body weights and in intercorneal distances were observed at frequent intervals as previously described. In addition the consumption of food was carefully determined.

Results. On administration of this crude thyrotropic preparation the animals were less lively than normal but there was no profound change in the animals' appearance or in their

¹Kindly prepared by the manufacturer for this experiment under the direction of Dr. F. Frey, and assayed and found to contain 3 International Units per 4 milligrams of powdered extract. See preceding foot note for definition of unit.

TABLE III — CHANCES OF INTERCORNEAL DISTANCE AND BODY WEIGHT OF ALL ANIMALS RECEIVING THE CRUDE THYROTROPIC PREPARATION

Daily dose	Operation	Days of treatment, month	Changes of body weight, gm.	Others, and exophthalmos, mm.	Corrected exophthalmos, mm.
30 mg.	T*		+11	50	30
	T	22	+22	3	3
	T+G†		+10	3	3
	T	2	+5	00	00
	T+G	2	-30	30	00
30 mg. for 5 days, followed by 40 mg.	T		+	00	00
	T	24	+5	22	3
	T	24	+14	2 1/2	2 3/4
	T+G	2	-2	00	00
	T+G		-40	72	22

*Thyroidectomy
 †Thyroidectomy and gonadectomy
 ‡The width of the (frontal) bones increased 5 mm. in each of these animals, an observation which explains in part the decrease of exophthalmos.

activities such as seen in animals receiving antuitrin T.

The food intake paralleled the changes of body weight (Fig. 6). Instead of losing weight as did the animals receiving antuitrin T these, for the most part, gained slightly. Two of the animals receiving the product for a longer time than the other animals gained considerable weight. In these 2 instances, the increase in intercorneal distance was due in part to the growth of the skull, for in these 2 animals the width of the frontal bones between the orbits increased 0.5 millimeter.¹

The exophthalmos produced by the amounts of this crude product given was not as striking as that produced by antuitrin T although the eye changes were grossly evident (Fig. 6 Table III). Previous orchectomy had no apparent inhibitory effect on the exophthalmos.

Although bio-assays, in Rowlands-Parkes units, of the crude and 'purified' products indicated that the amounts of thyroid-stimulating substance given were comparable, yet exophthalmos resulted only in animals which received the crude preparation. The difference in the exophthalmos-producing effect of the 'purified' and crude products is further illus-

trated by the prompt increase in the intercorneal distance of the two animals previously mentioned, which took place when the crude product was given although the animals had just previously failed to respond to the 'purified' product.

D. THE EFFECT OF THE SPECIFIC METABOLIC PRINCIPLE² ON THE PROMINENCE OF THE EYES OF GUINEA PIGS

In the two preceding experiments, it was found that a crude product produced both thyroid hyperplasia and exophthalmos. On the other hand, a so called purified product, which produced thyroid hyperplasia to the same degree failed to induce exophthalmos. The question arises whether in the process of purification an exophthalmos-producing substance may have been lost. This prompted an effort to find a substance which would produce exophthalmos but would not produce thyroid hyperplasia.

Billingsley, O. Donovan and Collip (3) separated a thyrotropic preparation into two fractions. The thyroid-stimulating fraction raised the basal metabolic rate over a period of a number of days by its stimulating effect on the thyroid. The other fraction, known as the specific metabolic principle, caused an elevation of the basal metabolic rate within several hours but did not induce hyperplasia of the thyroid.

Since antuitrin T induced a loss of body weight and a striking exophthalmos while the other products in the amounts given were less effective in these respects, a study of the exophthalmos-producing effect of the specific metabolic principle was undertaken.

Method and results. The specific metabolic principle was administered to 4 thyroidectomized guinea pigs. The previously described methods of observation were used. On the 3rd postoperative day the daily administration of 1 cubic centimeter of this product to 3 animals was begun. After 2 injections had been given and 48 hours had elapsed, there was no definitely demonstrable increase in the intercorneal distance in any of the 3 animals. The daily administration was then increased

¹This product conformed to the specifications described by its discoverers (3, 4).

²The method of control of skull growth is described elsewhere. (5)

to 2 cubic centimeters and the larger amounts also were given to a 4th animal. After 7 to 9 days there was still no evidence of an exophthalmos-producing effect from this product. It was noted that in the 2 animals in which a little more than 1 millimeter increase of intercorneal distance developed most of this increase occurred after thyroidectomy and before the administration of the specific metabolic principle. Data on this experiment are given in Table IV.

SUMMARY

The exophthalmos-producing effect of several different preparations of thyrotropic hormone has been studied. In addition the effect of the presence or absence of the testes and thyroid on the development of exophthalmos was observed. The gradual changes in the prominence of the eyes of guinea pigs have been observed by two improved methods of measurement which were used at frequent intervals.

It was found that 25 Junkmann Schoeller units daily of antuitrin T caused toxic manifestations, a loss of weight and a striking degree of exophthalmos in thyroidectomized as well as normal animals. A so called purified thyrotropic preparation given in quantities of 25, 50 and 100 Rowlands-Parkes units daily did not produce appreciable exophthalmos nor toxic manifestations in the thyroidectomized animals but did cause hyperplasia of the epithelium of the thyroid in intact animals. A crude thyrotropic product, given in the same concentration in terms of thyroid stimulating effect as the "purified" preparation produced exophthalmos and slight toxic manifestations in thyroidectomized animals as well as hyperplasia of the epithelium of the thyroid of intact animals.

In many instances the development of exophthalmos was recognizable within 24 hours after the administration of antuitrin T.

Because loss of body weight is usually associated with a regression of eyes and because many of the animals receiving antuitrin T lost weight, control observations were made on the regression of the prominence of the eyes of animals that were caused to lose weight by fasting. These observations contributed much to the interpretation of changes in the prom-

TABLE IV—CHANGES OF BODY WEIGHT AND INTERCORNEAL DISTANCE IN FOUR THYROIDECTOMIZED GUINEA PIGS RECEIVING SPECIFIC METABOLIC PRINCIPLE

Days of treatment	Change of body weight gm.	Observed increase of exophthalmos, mm.	Corrected increase of exophthalmos, mm.
1	+15	5	5
7	+23	5	5
7	+45	5	5
9	-27		50

inence of the eyes of animals that lost comparable amounts of body weight because of the effects of some of the thyrotropic products. A correction for the loss of weight and consequent change in the eyes in thyrotoxic animals indicated that the exophthalmos-producing quality of thyrotropic hormone was less effective in intact animals than in thyroidectomized animals. This difference was thought to be due to the superimposed exophthalmos-producing effect of thyroidectomy alone (6).

Because the specific metabolic principle raises the basal metabolic rate but fails to stimulate the thyroid and because it is a fraction of thyrotropic hormone preparations it was investigated for exophthalmos-producing qualities. This principle did not produce exophthalmos.

Approximately half of each group of animals that were studied were orchectomized. It was found that orchectomy had no inhibitory effect on the exophthalmos produced by thyrotropic hormone.

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MASSIVE ISLET CELL TUMOR OF THE PANCREAS WITHOUT HYPOGLYCEMIA

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NEOPLASMS of the pancreatic islet tissue are usually recognized clinically by their ability to produce hypoglycemia with vasomotor and central nervous system manifestations. The islet cell tumor need not be of large size to produce symptoms of hyperinsulinism and indeed it is unusual to find one of considerable bulk that fails to exert an appreciable physiologic effect. The great majority of these tumors are composed histologically of mixed alpha and beta cells or exclusively beta type cells and exhibit distinct secretory granules in their cytoplasm. In most instances growth is benign. A number of questionable and a few undoubted malignant cases have recently been carefully tabulated and discussed (1-4).

The case under consideration appears unique in that it concerns a patient harboring a singularly large islet cell pancreatic tumor without clinical or biochemical evidence of hyperinsulinemia. Histological study of the resected tumor showed it to be composed almost exclusively of functionally inactive delta type islet cells. Both the unusual microscopic composition and biologic behavior of this neoplasm appear worth recording.

CASE REPORT

A white female 40 years of age was first admitted to the pre-clinic on August 7, 1933 complaining of a periodic gnawing sensation in the epigastrium which appeared 1 to 2 hours after eating and radiated posteriorly to her back. These episodes had been present intermittently over a period of 4 years with symptomless intervals lasting 1 to 2 months. The pain was relieved by taking food and aggravated by fatigue. Her appetite was usually good apples were recorded as the only food for which she had an idiosyncrasy. There was no history of hematemesis, icterus, bloody or tarry stools. Investigation of her past history showed that 5 years previously she had had a uterine suspension and appendectomy per-

formed. Her convalescence was complicated by postoperative pneumonia. There had been no other known illnesses. Her husband had died some time previously and was reported to have had acquired central nervous system syphilis. A son by him exhibited interstitial keratitis. The patient had not received antiluetic therapy and two blood Wassermann reactions taken at this time were recorded as negative.

The patient was an obese, white female, weighing 203 1/2 pounds who presented tenderness to palpation in the epigastrium and over both right lower and upper abdominal quadrants. No masses were palpable. Some tenderness was present at the right costovertebral angle at the level of the 11th and 12th dorsal vertebrae. A roentgenologic study of the gastroenteric tract August 8, 1933 showed the stomach to be of the high transverse type exhibiting hypertonicity and hypermotility. No mucosal defects were demonstrable in the stomach or duodenum. Gastric analysis (Ewald test meal) showed a total hydrochloric acid content of 74 degrees and a limited acidity of 90 degrees. She was placed on a limited diet with alkali administration which relieved her pain and produced general subjective improvement. She was observed at intervals in the out patient department until 1935 when it became impossible to continue her visits as she was unable to take leave from her job to attend the clinic. She stated that she felt well except when she neglected to take the alkaline powders. She was not seen again until April 11, 1938 when she visited the gastric clinic after an absence of about 3 years. She stated that she had been well and free of symptoms until September 1937 when her previous complaints returned and became progressively more severe. She was forced to remain in bed during the month of February. Once during this period she suffered an attack of vomiting which culminated in a severe gastric hemorrhage and she was brought to a hospital and placed under observation for 1 week. Improvement under treatment was rapid though she continued to complain of a burning sensation in the epigastrium. She was advised to continue on a Sippy diet. Her weight was now 165 pounds. There was moderate tenderness to palpation in the right upper quadrant and pain was elicited over the descending colon. A firm mass having a sharp irregular edge was palpated below the costal margin in the left upper part of the abdomen. This was tender to pressure and was thought to be the spleen. Roentgenologic study performed on April 18, 1938 and repeated on May 3, 1938 showed the duodenal cap to be definitely deformed and irritable with extremely marked

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localized tenderness present. A diagnosis of acute duodenal ulcer was made. A blood Kahn test performed May 10 1939 was negative. The red blood cell count was 3,600,000 and the white blood cell count 5,000. Considering that the palpable mass in the left upper abdominal quadrant might represent a misplaced kidney, the patient was admitted to the hospital on the genitourinary service. Flat plates of the abdomen and bilateral retrograde pyelograms failed to reveal any renal abnormalities. She was discharged to the gastric clinic for further observation. On June 2 1938 a barium enema showed the palpable mass in the left upper abdominal quadrant to be medial to the descending colon and at the level of the lower pole of the left kidney. The colon was not displaced in this region. A gastroenteric series on July 19 showed no essential changes in the duodenum from the previous examination and the patient seemed improved on the prescribed therapy. On May 15 1939, she again returned complaining of having vomited intermittently during the preceding 5 weeks and of being unable to retain any food during the past week. She was admitted to the hospital feeling very weak and continuing to suffer from abdominal pain and repeated vomiting. The red cell count was 4,170,000 and the white blood cell count 8,500. The mass noted in the left upper abdominal quadrant remained unchanged to palpation and no new light was shed on its nature. She again responded well to medical treatment for her duodenal ulcer and was discharged as improved 1 month after admission and advised to continue on a Sippy diet. A return of her ulcer symptoms sufficiently severe to require hospitalization occurred again on October 31 1940. Physical examination was essentially unchanged from the last hospital examination. The roentgenologist now demonstrated the presence of a diverticulum of the proximal part of the second portion of the duodenum with irritation of the entire first and second portions and suggested that the mass might be in the pancreas. A spinal fluid Wassermann and gold curve were recorded as negative on December 12 1940. The patient was discharged on January 11 1941, with a clinical diagnosis of diverticulitis of the duodenum with probable ulcer formation. She was placed on Sippy powder and atropine. She was instructed to return to the gastric clinic. On January 29, 1941, she was readmitted with a familiar story of epigastric pain and vomiting. A severe attack of hematemesis had occurred 2 days prior to admission. Physical examination showed that the abdominal mass in the left upper quadrant first detected 5 years previously was present but no diffuse epigastric tenderness was present. A blood pressure reading was 132/85. The red blood cell count was 3,760,000 and a white blood cell count 13,700. Examination of a stool specimen for occult blood gave a slightly positive reaction to the guaiac test. Diagnosis of penetrating duodenal ulcer was made. Gastric resection was believed to offer the best hope for lasting relief of her symptoms. The upper left quadrant abdominal mass was thought to represent matted loops of adherent intestines and omentum, the result of leakage from the ulcer crater. The possibility of a retroperitoneal neoplasm of undetermined type was also considered.

On February 26 1941 an exploratory laparotomy was performed. The scar of a duodenal ulcer crater was seen and felt, but there was no crater present and no signs of activity. On exploring the left upper abdominal quadrant a circumscribed hard nodular mass was made out in the region of the body and tail of the pancreas. Closer inspection showed it to have apparently replaced most of this organ and to be adherent to the jejunum, stomach, and spleen. It was firm, well encapsulated larger than a fist, and fairly freely movable. No metastases could be made out. The mass was exposed through the gastrocolic ligament carefully dissected free and removed *in toto*. A large vein penetrating the mass was thought to be occluded by tumor tissue. It was stripped of its contents and ligated. The patient thereafter made an uneventful recovery. Gross examination of the excised tumor mass showed that the specimen consisted of a well encapsulated nodular grayish-white mass 12 by 8 by 6 centimeter in diameter. Firmly adherent to one portion of its surface and blending intimately with the substance of the pancreas was a flattened well lobulated portion of the tumor was about 2 by 2 centimeter in diameter. Elsewhere small tabs of adipose tissue were adherent to the tumor surface. The cut surface of the tumor was uniformly dark reddish-gray, one as though necrotic. Several small portions were removed from the surface of the tumor for microscopic examination. The remaining large mass was sectioned across its greatest axis into two equal halves. One of these was prepared for paraffin embedding on bloc the other used for further sectioning and study with different stains. The generous size of the tumor even if allowance is made for previous trimming and shrinkage following fixation, can be appreciated (Fig. 1).

Microscopic examination of sections taken from some hypertrophied portion of the pancreatic tail showed the still undamaged acinar tissue. The cells composing the islets possessed a rather abundant clear cytoplasm enveloping their uniform round central nuclei. This cell type bore a striking resemblance to small compact round areas of tumor infiltrating the tissue within the acinar areas of the gland (Fig. 2). The cell nuclei of the tumor cells however were larger the chromatin sparse and irregularly disposed in small threads. No nucleoli were present. With ordinary stains the appearance of the nuclei was unlike that of alpha or beta type cells. The tumor cells ranged from about 15 to 20 micra in diameter with the nuclei composing slightly more than one

half of the cell diameter. Special stains for cytoplasmic detail, by means of both the Mallory Azan and the Gomori techniques failed to reveal the presence of alpha or beta cell granules. Sections taken from numerous widely separated portions of the tumor showed a strikingly uniform cell type and arrangement resembling the delta cell of pancreatic islet tissue. In most instances the tumor was composed of broad sheets divided by elongated connective tissue trabeculae of varying thickness (Fig. 3). Some zones were completely walled off into circular nests of round and oval cells. In a rare zone the cells became more columnar resembling duct epithelium. The cytoplasm of the cells in the larger zones stained light pink with eosin with an occasional one showing a clear zone about the nucleus. All portions of the tumor possessed a rich vascular supply. About some capillaries the cells assumed a rosette pattern. In a few areas small clumps of cells were found lodged within the lumina of the vascular channels. No portion of the tumor showed any striking variation in cell size or shape. Mitotic figures were present but not numerous. The thin capsule surrounding the tumor was invaded by nests of uniform tumor cells at many points and these cells also penetrated adherent tags of adipose tissue. One attached small pericapsular lymph node embedded with the adjacent fat was almost entirely replaced by tumor.

On account of the finding at operation of tumor in the lumen of a large vein she was given postoperative deep x ray therapy and received 10,400 roentgen units between March 17 and April 25 1941. For several months she complained of some pain in the region of the incision but this gradually disappeared and at her last examination at the clinic on February 20 1942 she was remarkably free of any symptoms. Roentgenologic examination December 17 1941 still showed deformity of the duodenal cap and the presence of a diverticulum of the second portion of the duodenum.

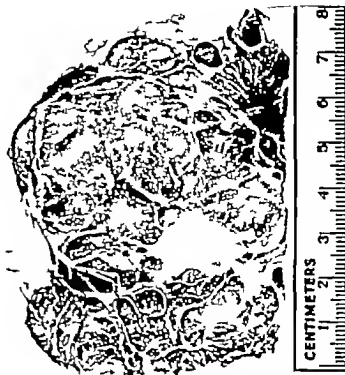


Fig. 3. Cross section of original tumor after fixation and staining.

The patient was seen again May 15 1943, by request. She had remained free from any digestive disturbances. Her appetite was good and she had regained her usual weight weighing 210 pounds. She said that recently there had been some discomfort in the abdomen to the left of and just above the umbilicus. On examination the incision was well healed but an indefinite mass could be felt in about the position occupied by the original tumor. This mass was difficult to outline because of her obesity but apparently did not descend with res-

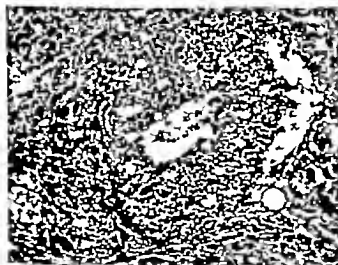


Fig. 2. Portion of tail of pancreas infiltrated by tumor cells bearing a resemblance to islet tissue.



Fig. 3. Broad sheets of uniform appearing cell types composing the bulk of the tumor.

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piration. The liver was not enlarged and the spleen could not be felt. A ray films of the gastroenteric tract showed the stomach to be of the transverse type. There was slight deformity of the transverse bulb. The second and third portions of the duodenal stomach but did not displace it. The colon was negative roentgenologically and its relation to the mass was not determined. The lungs and mediastinal structures appeared normal. Clinically it seemed likely that the tumor had recurred. In the absence of any striking symptoms she was unwilling to consider any further studies or exploratory operation at this time.

In July 1943 the patient consented to enter the hospital for a glucose tolerance test which was essentially normal.

Fasting	Milligrams per cent
1 hour	95
2 hours	26
3 hours	6
4 hours	93
	8

About 1 year later July 13, 1944 she entered the hospital complaining of headache of several months' duration and vomiting of 4 weeks. She also had attacks of dizziness. She said she had lost about 20 pounds in weight though he still weighed 192 pounds. The liver was found to be moderately enlarged with a nodular edge and a mass on the left side about the size of a fist was found. A glucose tolerance test again showed an essentially normal pancreas as follows:

Fasting	Milligrams per cent
1 hour	97
2 hours	57
3 hours	63
4 hours	3
	95

A blood sugar determination made from blood taken during one of her dizzy spells was 83 milligrams per cent.

On August 1, 1944 a laparotomy was performed and disclosed a recurrent tumor involving the pancreas numerous nodules in the liver and several in the mesentery and omentum. One nodule about 3 to 3 centimeters in diameter in the omentum was removed. Microscopic examination showed an appearance exactly like that of the original tumor.

The patient was discharged from the hospital September 2, 1944 apparently improved. She had minor attacks of abdominal pain and occasional vomiting for which she was given fairly large doses of tincture of opium. On November 6, 1944 she was suddenly seized by intense epigastric pain and vomited coffee ground material. She was admitted to the hospital and although it seemed of virus that she had had a severe intra-abdominal accident, she was treated by nonoperative measures in view of the known extensive malignant disease. Continuous

gastric suction and large doses of opiates gave her considerable symptomatic relief but the temperature and pulse rose and she died November 10, 1944.

Autopsy was performed 3 hours post mortem, the following being an abstract of the pathologic report.

Anatomical diagnoses were (1) mesenteric lymph nodes with infarction of jejunum and hemorrhagic metastasis to liver, urinary bladder, uterus and mesentery. (2) duodenal ulcer (chronic).

On opening into the peritoneal cavity 15 cubic centimeters of blood tinged fluid was found. It was immediately noted that a section of jejunum 30 centimeters in length had a dark purple-red surface. This extent of bowel was very slightly dilated but no constriction, volvulus or telescoping was found. The mesentery of this segment of intestine was very dark red and anteromortem blood clots were demonstrated in the branches of the mesenteric arteries and veins. The portal vein was occluded by an old blood clot and apparent tumor mass. The head of the pancreas was replaced by a tumor mass 12 centimeters in diameter which projected behind the duodenum and into the lesser curvature of the stomach. The tissue was granular and varied in consistency from mushy to moderately firm. The tail of the pancreas was replaced by another large tumor mass measuring 6 centimeters in diameter. No normal pancreatic tissue was recognizable. The spleen vein was surrounded and occluded by tumor growth. The regional lymph nodes appeared normal (irregularly) roughened external surface due to a projection of nodules varying in size from 1 to 4 centimeters in diameter. These nodules were soft, mushy and white on the cut surfaces. They were manifestly neoplastic and occupied a considerable proportion of liver volume. The recognizable liver was dark brown, soft and slightly friable. Part of the portal system was occluded by tumor growth.

Microscopic examination revealed giant cell carcinoma of the pancreas with massive infiltration of the liver widespread necrotizing nodal necrosis of the liver severe hepatitis organizing phlebotomies marked glycogenic infiltration of liver mesenteric venous thrombosis with jejunal infarction and early gangrene acute mesenteric arteritis splenic infarction chronic interstitial fibrosis of pancreas organizing thrombus of pulmonary arterioles mild focal atelectasis and pulmonary emphysema.

The tumor tissue obtained at post mortem took exactly like the original tumor and the metastatic nodule removed in August 1944.

SUMMARY

A large tumor of the pancreas was removed from a 48 year old woman who was known to have had a palpable mass in the abdomen for 2 or 3 years but whose symptoms were

those of duodenal ulcer. Study of the tumor showed it to be an islet cell tumor of the pancreas. Gross findings at operation and microscopic study indicated that it was malignant. At no time were there any symptoms of hypoglycemia and several glucose tolerance tests were normal. Local recurrence and widespread metastases occurred and the pa-

tient died 3 years and 10 months after removal of the tumor the immediate cause of death being mesenteric thrombosis.

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THE SURGICAL REPAIR OF THE DEEP BRANCH OF THE RADIAL NERVE

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THE injuries to the extremities in war result in large numbers of peripheral nerve injuries. In a 12 months period 329 explorations of peripheral nerves have been done at this hospital. Of these 232 were operations for nerve injuries in the upper extremities, 51 were explorations of the radial nerve. In 15 instances the radial nerve has been explored distal to its point of division into the deep (motor) and superficial (sensory) branches.

The injuries to the deep branch of the radial nerve have been due to penetrating wounds of the forearm, extensive soft tissue wounds and fractured bones of the forearm have been the usual associated injuries. The deep (motor) branch of the radial nerve is well protected from pressure, contusion and superficial injuries. Its injury is rare in civilian life and the characteristic deformity and function loss are most often seen in the regenerating common radial nerve before the regenerating axones have reached the most distal muscles or those supplied by its deep branch.

It has been regarded that the repair of the radial nerve distal to the point of division into the superficial and deep branches is generally not satisfactory. This was thought to be due to the small caliber of the radial nerve distal

to its point of division and because of the difficulty in obtaining sufficient length to close any appreciable defect existing in the continuity of the nerve. Mayfield found these unfavorable factors in the technique of nerve repair could be overcome and usually a satisfactory repair could be accomplished. There are two especially favorable conditions for regeneration in this particular nerve: first, it carries only motor fibers and, second, only a short distance must be bridged before the regenerating axones reach their motor end plates.

Interruption of continuity of the radial nerve distal to the origin of the deep and superficial branches is also distal to the site of origin of at least one motor branch to the extensor carpi radialis muscle group. Consequently extension of the hand at the wrist is not lost, though it is impaired. In the position of extension the hand has a characteristic radial deviation due to the loss of function of the extensor carpi ulnaris muscle. Associated with this functional deformity at the wrist is the loss of extension of the metacarpophalangeal joints of the fingers and thumb, the loss of extension of the distal phalanx of the thumb and abduction of the thumb (Fig. 1).

Such a lesion produces a characteristic deformity as well as serious functional loss.



Fig. 1

Fig. 1. Characteristic deformity associated with deep radial nerve paralysis. Note extension of first thumb radial deviation, loss of extension of all metacarpophalangeal joints and loss of abduction of thumb.



Fig. 2

Fig. 2. Side view of characteristic deformity. Loss of abduction and extension of thumb obstructs entry of objects into grasp of fingers. Loss of extension of fingers reduces the reach of the grasp and impairs fine movements of fingers.

Fig. 3. For illustration the extensor carpi radialis muscles have been divided transversely and reflected. The deep branch of the radial nerve spirals posteriorly around the neck of the radius and passes between the superficial and deep planes of the supinator brevis muscle. The extensor carpi radialis brevis and the extensor digitorum communis muscles have been separated to expose the branching of the deep radial nerve as it emerges from the supinator brevis muscle.

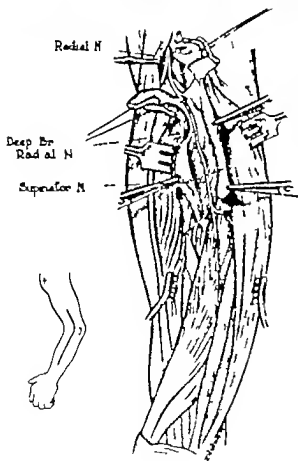


Fig. 3.

Grasping objects is greatly impaired as the dorsum of the thumb impinges on the object. The thumb must first be abducted with the opposite hand in order to encircle the object and oppose the fingers. The fingers cannot be extended to open the hand for grasping; the dorsum of the fingers is slid over a fixed object until the finger tips pass over it and it then comes under the flexion function of the fingers. The loss of fixation of the metacarpophalangeal joints by the extensor tendons results in loss of fine movements of the fingers. Abduction and adduction of the fingers are impossible unless the metacarpophalangeal joints can be extended (Fig. 2). The functional loss resulting from a lesion of this terminal branch is almost as disabling as the loss of the common radial function of the mid arm. Interruption of the continuity of the motor branch of the radial nerve distal to its site of division may result in loss of any one of the functions mentioned depending upon the nerve branch injured (Fig. 3).



Fig. 4 Dissection of radial nerve showing injury to radial nerve proximal to site of division and site of foreign body in the deep branch. The entire area was resected and a satisfactory end-to-end suture accomplished. 1 Common radial nerve. 2 scar between common radial nerve and superficial and deep radial nerves. 3, deep branch of radial nerve. 4 superficial branch of radial nerve.

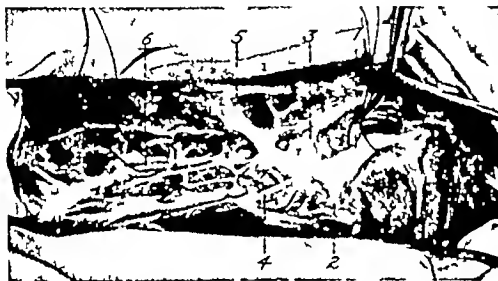


Fig. 5 Findings at operation of patient shown in Figure 3. There is scarring of the deep branch of the radial at its site of division. The extensor carpi radialis and the extensor communis digitorum muscle group have been separated. The vein retractor is holding back the cut superficial portion of the supinator. The branches labeled show the muscles supplied. A branch arising below the supinator muscle to the extensor carpi radialis longus muscle is commonly demonstrated by electrical stimulation though not generally described in the anatomical texts. 1 Deep branch of radial nerve. 2 nerve to extensor carpi radialis muscle group. 3, nerve to extensor communis digitorum muscle. 4, nerve to extensor carpi radialis brevis muscle. 5, nerve to extensor carpi ulnaris and extensor digiti minimi muscles. 6, nerve to abductor pollicis longus and brevis muscles.

The anatomy of the nerve can be described by the surgical approach. An incision is made on the anterolateral aspect of the lower third of the arm lateral to the elbow joint. It is continued on the dorsum of the forearm to the junction of the middle and lower thirds of the forearm in the palpable groove between the extensor carpi radialis muscle group and the extensor digitorum communis muscle. Such an incision passes posterior to the lateral cu-

taneous and anterior to the posterior cutaneous nerve of the forearm and does not cross the flexion crease of the elbow. It allows the anterior border of brachioradialis muscle in arm and forearm and line of cleavage between extensor communis digitorum and extensor carpi radialis muscles to be easily explored.

The cleavage line between brachioradialis and brachialis muscles is then developed and as the brachioradialis muscle is retracted lat-



Fig. 6. End-result in Case 2. Note tendons of extensors and abductor of thumb. There is residual weakness of the extensor of the middle finger.



Fig. 7. Result in Case 3. Note loss of most proximal portion of substance of extensor muscles from initial débridement of wound. The residual muscles provide satisfactory extension and abduction of the digits following nerve regeneration.

erally the common radial nerve is exposed. Branches to the brachioradialis and extensor carpi radialis longus muscles emerge from the lateral side of the nerve. The medial side is safe for dissection.

The radial nerve usually divides into the superficial and deep branches at about the level of the elbow joint (Fig. 4). The more medial or superficial branch of the nerve can be traced downward into the forearm beneath the brachioradialis muscle. It becomes subcutaneous in the distal third of the forearm. This is a purely sensory nerve and its injury is of minor importance when compared to the injury of its motor division.

The second terminal branch of the radial nerve is ordinarily known as the posterior interosseous branch, the deep branch, or the motor branch. This nerve passes anterior to the capsule of the elbow joint, then continues laterally and posteriorly to curve about the neck of the radius beneath the superficial portion of the supinator muscle. A motor nerve branch to the supinator muscle is usually given off the lateral side of the deep radial nerve a short distance above its passage into the supinator muscle.

To expose the nerve distal to the supinator muscle the dissection is made on the dorsum of the forearm. There is a palpable groove

between the extensor carpi radialis and the extensor digitorum communis muscles in the middle third of the forearm and dissection will develop this line proximalward along the intermuscular septum from which some of the muscle fibers of both groups of muscles originate. When the extensor carpi radialis muscles are retracted laterally and the extensor communis digitorum muscle is retracted medially the deep branch of the radial nerve will be exposed at its point of emergence from the supinator muscle. Medial branches to the extensor communis digitorum and additional lateral branches to the extensor carpi radialis muscles are given off only a short distance from its site of emergence from the



Fig. 8. Result in Case 4. Near complete abduction of thumb and extension of the digits has been regained.



Fig. 9. Extension of wrist and digits obtained by tendon transplantation. Deep radial nerve was irreparable.

TABLE I

Case No.	Date	Location of lesion in relation to supinator muscle	Defect in cm	Operative procedure	Result
	6-30-44	Distal	4	Repair	Return of function (Fig. 6)
	7-10-44	Distal	5	Unsatisfactory repair	Lost to follow-up
3	9-1-44	Distal		Repair	Return of function (Fig. 7)
4	9-30-44	Proximal	4.5	Repair	Return of function (Fig. 8)
5	0-2-45	Distal		Neurolysis	Lost to follow-up
6	2-15-45	Proximal and within		Irreparable	Tendon transplant
7	2-23-45	Within (this and distal)	8	Irreparable	Tendon transplant
8	3-3-45	Within and distal	9	Irreparable	Tendon transplant
9	4-2-45	Within	4	Repair	Too recent for evaluation
	4-2-45	Proximal	7	Repair	Too recent for evaluation
	4-3-45	Distal		Neurolysis	Too recent for evaluation
	4-6-45	Proximal	7	Repair	Too recent for evaluation
11	4-0-45	Distal		Neurolysis	Return of function
12	4-18-45	Distal	4	Repair	Too recent for evaluation
13	4-1-45	Within	4	Repair	Too recent for evaluation

supinator muscle. The nerve then becomes much smaller in caliber and may give off additional medial and lateral branches but the main trunk continues distalward to reach the extensor pollicis longus and brevis and the abductor pollicis longus muscles. These are terminal branches of the nerve (Fig. 5).

In the surgical exposure of the deep branch it will probably be necessary to incise the superficial portion of the supinator muscle in order to obtain complete visualization and gain length to obtain an approximation if a segment of the nerve has been destroyed. Transplanting the nerve superficial to the supinator and elevation of the common radial to a more superficial position beneath the brachioradialis and flexion of the elbow with the nerve transplanted more superficially permits large gaps to be sutured without tension. An accurate approximation of only the epineurial sheath with fine suture material with out tension is the essential requisite for nerve suture. The minimum of foreign body and trauma at the line of suture insures minimal inflammatory reaction and fibrosis. If the nerve is injured at the site of its branching the distal filaments should be approximated by fine sutures through the sheath in order to form a single distal trunk. A more satisfactory end-to-end suture can be obtained in

this way than in trying to suture each branch to the single proximal trunk. Following suture of the nerve the elbow is immobilized in a position of flexion for a period of 4 weeks and then gradual extension is permitted to take place.

To close a defect by stretching the nerve either at the time of operation or postoperatively results only in fibrosis of the stretched section and prevention of regeneration. It will be impossible to repair some defects even after an extensive mobilization and transplantation of the nerve to a more superficial position. In these patients tendon transplant will have to be resorted to. The defects in the deep radial nerve in this group of patients are listed in Table I. In the 15 patients in which the deep radial nerve was explored it has been possible to obtain a satisfactory end-to-end suture in 8. In 3 of these sufficient time has elapsed to expect regeneration and all 3 have shown excellent return of function (Figs. 6, 7 and 8). Four have been regarded as technically irreparable due to extensive loss of nerve tissue. Of these 3 have been referred to the orthopedic section for tendon transplants (Fig. 9). A neurolysis has been done in 3 patients. In these continuity of the nerve was intact. Two of this group have had return of nerve function since the neurolysis was done.

SUMMARY

The results to date in 15 cases of exploration of the deep or motor branch of the radial nerve are given.

The deep or motor branch of the radial nerve should regenerate well because of its purely motor character and the short distance regenerating axones must span before reaching their motor end plates.

The characteristic deformity and function loss is described and the surgical anatomy discussed. By sufficient mobilization and transplantation of the nerve moderate defects in the continuity of the nerve may be closed and satisfactory repair may be accomplished.

The early results have been sufficiently good to warrant exploration of injuries to the terminal motor portion of the radial nerve with an attempt to restore its continuity. If destruction of the nerve is of such extent that repair is impossible tendon transplant to obtain extension of the digits and abduction of the thumb should be done.

Additional data have been obtained since this paper was submitted for publication. Twenty-four explorations of the deep branch of the radial nerve have been done in 14 instances, as listed in Table I. The nerve was irreparable. Sixteen of the nerve was required in 3 patients. Of these, 9 have shown return of function, 2 are showing beginning return of function, and 2 have shown no evidence of regeneration. Lysis of the nerve was done in 7 patients. All have shown return of function.

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THE TREATMENT OF BURNS

Report of 155 Cases

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THIS series of burns includes 155 patients admitted and treated during 1 year. There were 97 admitted from forward hospitals where the primary dressing was done and 58 admitted directly from the scene of accident with first aid but without initial definitive care. Twenty six cases or 17 per cent of the entire series, were third degree burns the percentage being about the same in the two groups.

This discussion will concern itself almost entirely with the treatment of third degree burns with a description of the methods used and with emphasis on strict adherence to established surgical principles. Not much attention has been paid to the type of emollient used for primary dressings because throughout the series it has been observed that other factors seemed more important. In the group of patients admitted from forward hospitals, a wide variety of materials was used in the group admitted here directly from the scene of accident, all were treated identically and the results were similar in the two groups. It was felt, therefore, that factors other than the emollient were the ones to consider as important. Gradually throughout the series, an attempt was made to improve technique and shorten the time required to get complete skin coverage. By the end of the series, we were accomplishing our aim of obtaining complete skin coverage of third degree burns within 4 weeks of the date of injury.

CLASSIFICATION

Before discussing treatment it is important to establish the method by which a first, second or third degree burn was diagnosed. When erythema only was noted the diagnosis was first degree. When erythema plus blisters appeared the tissue under the blister was inspected as well as could be done without dis-

turbing the blister. When the base of the blister revealed the dermis to be pink and covered with a network of fine blood vessels appearing as multiple red dots a diagnosis of second degree burn was made. However, when the dermis under the blister was sallow in appearance or there were only a few visible vessels a diagnosis of third degree burn was made. Naturally if the destruction went beyond the blister stage to charring the diagnosis was obviously third degree. In all patients admitted from forward hospitals, the diagnosis made at the forward hospital was accepted and recorded. In only 1 instance was it necessary to change the diagnosis this injury being a phosphorus burn which was originally called second degree but which eventually required grafting of skin. Certainly infection in the management of these patients did not make third degree burn wounds out of those that should have healed without operative repair.

INITIAL TREATMENT

All cases of the two groups had the following treatment (1) prompt attention (2) plasma 50 cubic centimeters for each 1 per cent of body surface burned given during the first 24 hours (3) morphine for comfort (4) thick pressure dressing with fine mesh gauze next to the burn over a nonirritating emollient (5) immobilization by the use of pressure dressings with stockinette or elastic pressure (6) warmth and rest (7) no change of primary dressing for 7 to 10 days.

All patients from forward installations arrived here in about 4 to 6 days in excellent condition taking a full diet. In a few the dressings needed to be reinforced because of shifting in transportation but most of them required no immediate care.

All of the 58 patients admitted directly to the hospital from the scene of the accident had identical care. They were taken from re-

From a hospital in the Communications Zone.

ceiving to the operating room where all the personnel were required to wear masks and where sterile technique was followed. None of them was anesthetized none was debrided. Blisters were not disturbed. When mud or dirt from the street had soiled the burned surface it was washed gently with a warm mild soap solution. When no obvious surface contamination was present, no cleansing was done. Some were brought in with a thin dressing over the wound a few had had a topical application of an ointment. These dressings were removed but no effort was made to remove any medication. Morphine in the meantime was given to those who had none before admission and plasma was started at once by the operating room personnel. As rapidly as possible sulfadiazine cream in fine mesh gauze strips which is kept available for that purpose, was laid smoothly over the burned surface. Gauze pads, followed by full thickness cellulose absorbent pads were applied then sheet wadding and plaster of paris for extremities, in order to get maximum immobilization. A section of stockinette was used over the heavy pads for the face and head with holes cut for eyes, nose and mouth. Over the trunk the padding was supported by ace bandage.

Even in the extensive burns, the dressing was completed by the time 1 unit of plasma had been given, so the patient, having been kept warm in the meantime, was taken to the ward and put to bed. A note indicating how much plasma he was to receive accompanied the patient to his ward. This amount was calculated rapidly on the basis of 1 unit for each 5 per cent of body surface and usually the entire amount was given promptly without interruption in order to prevent hemoconcentration and shock. Warm drinks, rest and quiet were the rule for these patients and usually in a few hours they were ready to eat. Even though many patients had severe burns none developed shock, probably because of the prompt administration of a calculated amount of plasma. Within the first 24 hours copper sulfate determinations were done to evaluate the hemoconcentration. Plasma or whole blood was given as indicated. On the seriously or extensively burned patient, this checkup was repeated frequently during his

entire stay in the hospital and blood or plasma supplied whenever indicated. After the initial amount had been given, very few patients required additional plasma. Whole blood, however was used in the later treatment of some patients and will be discussed later.

Of the 129 first and second degree burns, all returned to duty. They had an average of 8 per cent body surface burned and were in the hospital an average of 28 days. No complications developed in this group and none required transfusions. All were treated by initial pressure dressings. Some received chemotherapy others did not, and since the results were good gradually less attention was given to chemotherapy in the first and second degree burns. This subject will be discussed in more detail under a separate heading.

LATER TREATMENT

In the first and second degree burns, dressings were changed at approximately 8 to 10 days. These patients were without exception taken to the operating room where sterile technique was the rule. All were premedicated with morphine and atropine, and sodium pentothal anesthesia was used whenever the change of dressing was painful. In approximately half of these cases no subsequent dressing was required. When required areas were cleansed with warm saline sponge fine mesh gauze strips, dry or impregnated with sulfadiazine cream, were laid smoothly over the burned surface and were covered again by padding and pressure immobilization exactly as at the initial dressing. Dressings were changed in the operating room at about weekly intervals until recovery.

In a few cases there was some evidence of exudate and infection but no cultures were made. This infection cleared rapidly and in no instance did it become a cause for a change in the management of the first and second degree burns. All of these soldiers returned to duty in this theater of operations.

The third degree burns cannot be dismissed as simply and it is with these patients that we were most concerned. Their management required the utmost patience and persistence and after the initial few days had elapsed their treatment was aimed at prevention of infec-

tion coverage by skin grafting and supportive measures. It was our observation that the longer skin coverage is delayed, the greater is the problem of infection and supportive therapy. Also the greater the infection the more difficult the skin coverage. It thus became a race between the surgeon with his skin grafts and the wound with its bacteria.

In this series there were 26 patients with third degree burns, with an average of 20 per cent of body surface involved, all of whom required skin grafts. Two distinct types of pathology were noted in these wounds. Those who had damage but not destruction of the full thickness of skin usually had a gradual slough of dermis down to the subcutaneous tissue during the first 2 weeks. Under this slough then appeared the granulating surface. Usually the sloughing was not complete at the first dressing so the patient was redressed and returned to the operating room in about 4 days. Usually by this time 2 weeks after the burn skin replacement was started.

The other type of third degree burn encountered was that in which the entire thickness of skin had been destroyed. By 14 to 21 days the entire area was well demarcated. It has been our experience that it is best not to wait for this eschar to loosen and it is a decided mistake to leave it intact until fluid collects under it. As soon as the area of demarcation became evident, the entire eschar was removed by sharp dissection. This procedure was usually carried out about 2 weeks after the burn. Very little bleeding was encountered and secondary hemorrhage was controlled by pressure dressings. In a few days the area was covered by granulation tissue and grafting was started.

On several of our recent patients we have placed very thin grafts directly on the subcutaneous fat at the time of removal of the destroyed skin without waiting for granulations to form and we have been gratified to see that about 90 per cent of these grafts were successful. In the future we expect to start grafting promptly after removal of the eschar because from the standpoint of infection the area is as clean as it ever will be.

It has been our experience that from the time the damaged or destroyed skin is re-

moved skin replacement must be pushed vigorously until the entire area is covered. Naturally in extensive burns it is impossible in most instances to do a complete coverage at one operation. The length of the period of anesthesia and the availability of donor sites limit the amount of work that can be done. No other factor however should be permitted to delay the procedure. In some of our early cases we delayed because it was felt that the area was in no condition to receive skin. Always this was later regretted. It is difficult to improve an area and the probability of its becoming worse is very real. In a number of instances in which we have grafted areas that were thought to be poor recipient sites we have lost the grafts but almost always the area improved sufficiently by the skin dressing so that the next attempt was successful. Skin dressing has been our most successful agent in combating infection with its complications. One of our recent patients with 35 per cent body surface involved had the eschar dissected and removed on the 14th and 18th day after being burned. The grafts were applied the 18th, 22d and 27th day and the area was completely covered at that time. He may require a few minor plastic procedures in the future but certainly he has been saved months of disability by prompt and vigorous application of skin.

SKIN GRAFTING

The procedure of skin grafting in the treatment of burns is not the problem of a plastic surgeon. The primary purpose of transplanting skin is to facilitate rapid wound healing in order to preserve the deeper structures involved and maintain the general condition of the patient. Whatever procedures might be necessary later to improve the skin function of the grafted area was not given too much consideration at the time of the original grafting. Whenever possible thicker and larger grafts were placed in the axilla popliteal space, and other areas where danger of cicatricial contracture is present, but always the type of graft that was most certain to grow was used. The healing of the wound and preservation of the muscles vessels tendons and joints were the primary considerations.

Then if the individual could be cured of his burn remain in good general condition with no loss of function of deeper structures, and be completely covered by good skin instead of tender adherent contracting scars we felt that the treatment of the burn had been adequate. Whatever later skin substitution is necessary becomes a problem for the plastic surgeon but originally skin coverage was done to save the patient, prevent sepsis and preserve function. Speed of coverage was the watchword and small thin grafts lent themselves better to this type of surgery than larger and thicker sections.

TECHNIQUE

In an effort to get skin coverage in the shortest possible time we have tried several methods of grafting. Because of the pressure of work in this theater of operations and since burns seemed to occur when casualties were heaviest, their care coincided with the care of many other injuries. Also with occasional change of personnel simplification of technique was necessary.

At first we followed the accepted technique of cutting grafts and placing them in saline as they were removed. After all the grafts were cut, they were spread on a moist rubber dam and transferred to the recipient site. This procedure involved unfolding and smoothing out curled edges, as the graft slipped to and fro on the recipient site and possibly suturing the graft in place. This method was so time consuming and irksome that it was finally discarded.

Next we tried a method which as far as we have been able to determine has not been advocated probably because of the possibility of infecting the donor site. This method is the immediate direct transfer of skin from the donor to the recipient site without passing through saline. We were surprised and pleased with the result. First, it reduces the time required to cover a given area to about one-fourth of the time needed when the section is passed through saline solution and permitted to contract and curl up. Second the adhesive quality of the freshly cut surface causes it to nestle and cling to its new bed so tenaciously that in a matter of minutes it is

almost impossible to disturb it. Sutures are never necessary.

By the direct transfer particularly of small easily handled sections the cutting instrument carries the graft to its new site, and a forceps or any available instrument fixes one end of the section. The knife, as it is pulled away smooths the graft over its new home. Even the under sides of suspended extremities can be grafted easily. Graft after graft is laid end to end and side by side, going to and from the donor site so that an entire extremity can be covered in the time ordinarily required to cover the anterior aspect of a leg. The procedure is done easily rapidly without annoyance the grafts adhere well, grow readily and skin grafting becomes a pleasure. No infection of donor site has occurred.

In recent years, much has been written on the application of adhesive substances to the grafts or recipient site. We have had no experience with the acacia preparation or plasma thrombin or with any other adhesive substance, but believe its use is sound. However, by the immediate direct transfer without washing in saline, we have preserved nature's own adhesive substance to fix the graft to its new location without the use of added adherent.

After the grafts were placed fine moist gauze moist but not wet, was laid evenly over the area. Gauze pads and abdominal pads for gentle pressure were applied. Plaster of Paris casts were put on extremities ace bandage was used over the trunk, with figure-of-8 for the buttocks and 8 inch stockinette hood for the head and face. Donor sites were sprinkled with sulfanilamide crystals and covered in the same manner as was the grafted area. Four to 6 days later the patient was brought back to the operating room for subsequent grafting of additional areas or a patch here and there where a small area failed to obtain coverage.

Most of our grafts were cut very thin, the average thickness of grafts being less than 0.010 inch. In our experience generally speaking the thinner the graft, the better it will grow. Also the recovery of the donor site was much more rapid when thin sections were used. This factor was important in the 11 cases in the series of patients who had over

25 per cent of body surface involved. In these cases it was sometimes necessary to use some of the donor sites more than once. It has been our observation however that skin cut from a previously used site does not grow as well therefore we used a fresh site whenever possible. Most of the donor sites were healed sufficiently to go without dressing in 8 days.

INSTRUMENTS

In an active theater of operations where the patient load at times may become tremendous the problem of keeping instruments available and in working condition is a very real one. With a large number of burns requiring grafts and several surgeons at work every instrument that was available adaptable to skin grafting and sharp was pressed into service. When the donor sites were adequate the Padgett dermatome available and blades sharp, the dermatome was used. However since sections cut with the dermatome did not lend themselves easily to direct transfer the Blair knife or a Gillette type razor blade was used more often and the dermatome used only for the coverage of special areas such as axilla or popliteal space. The razor blade grasped by a curved Kelly forceps, was the ideal instrument when small sections were desired or only a spot here and there needed to be covered. It can be used well by anyone. Those of our group who had never done skin grafting became experts in one easy lesson. By grasping the blade with a curved forceps, held in the right hand while the left hand steadies the field a strip of skin an inch wide and as long as the donor site will permit can be cut rapidly and easily without assistance. This method lends itself well to the direct transfer of grafts. It has the added advantage of always being available and sharp. A supply of razor blades was kept in sterilizing solution so that the decision of whether or not to graft was never influenced by the availability of sharp instruments.

With rapidly healing donor sites availability of sharp instruments, and simplicity of method our group rapidly assumed the attitude that skin is expendable and grafts were placed whenever and wherever possible. In fact some grafts were placed on recipient sites

that looked impossible frequently with very gratifying results. For example, an area from which a charred eschar was dissected 10 days after being burned had skin placed over a layer of subcutaneous fat that from all appearances was blessed with only a very meager blood supply. Four days later when the dressings were removed the skin was growing nicely and continued to do well. Areas with granulations so exuberant and vascular that they could not be trimmed down because of bleeding were covered satisfactorily. Areas with soupy exudate were covered by thin sections which grew. In general, our aim was to get skin coverage at the earliest possible moment, and the more vigorously this policy was pursued the better were our results both in patient comfort and ultimate function of extremities.

CHEMOTHERAPY

Chemotherapy usually varied directly with the extent and degree of the burn. With first and second degree burns, very little drug of any type was used. Recently these patients have received none and are apparently doing as well as those who received sulfonamides. In the third degree burns nearly all were given either a sulfonamide or penicillin. In the early cases when supplies of penicillin were limited sulfadiazine, 4 to 6 grams daily was given with frequent checks of blood level. Those patients who showed evidence of sepsis were put on penicillin 25 000 units every 3 hours. Usually this was continued for about 10 days while skin grafting in stages was continued. One soldier with over 40 per cent of body surface involved had penicillin for 30 days, 200 000 units daily while skin grafting proceeded. At present we are using penicillin therapy in all extensive third degree burns.

Locally sulfadiazine cream in fine mesh gauze was used as the initial dressing and was continued on subsequent dressings until it was established whether the burned skin was being saved or lost. On donor sites we sprinkled sulfanilamide crystals and covered these with fine mesh gauze and pressure dressings plus immobilization just as for the burned areas.

A stimulating dose of tetanus toxoid was given to all shortly after the injury.

SEPSIS

If and when infection developed in the open wound of a third degree burn the problem was a real one. Particularly was this true in the summer when flies abound. Some patients during transportation could not be adequately protected from flies and at the removal of the initial dressing it was not uncommon to encounter maggots. Once hospitalized at a fixed hospital where the treatment could be carried on without interruption, adequate fly control rigid use of nets sprays and screening when available soon reduced the flies.

The infection of *Bacillus pyocyaneus* with its bluish exudate was frequently present. When the exudate was not profuse it was disregarded and grafting continued. When profuse openings were put into the cast and 0.5 per cent acetic acid in small quantities was used to moisten the dressings once daily with good results.

With mild infections of other invaders sulfanilamide was sprinkled over the wound and sulfadiazine given by mouth. In our recent cases, however we have used only penicillin 25,000 units every 3 hours continuously at the first sign of fever or purulent exudate. Meanwhile skin grafting continued.

When the subcutaneous tissue became involved phlegmonous, and swollen wet dressings of moist, warm boric acid solution were used. Pressure dressings as before were used except that muslin or ace bandage was used for a cover instead of plaster of Paris. Skin grafts under this treatment did not take as well but were continued because the results were still better than 50 per cent successful.

Tub baths were not available.

Sulfadiazine cream strips were not used in the presence of exudate from infection because it was felt that a nongreasy dressing would better absorb the material. Neither was this considered a good dressing over freshly laid grafts because of the possibility of causing the sections to slip.

BLOOD REPLACEMENT

None of the patients with first and second degree burns required transfusions. All had plasma, 1 unit for each 5 per cent of body surface involved.

Nine of the 6 patients with third degree burns required transfusions and a few required additional plasma. In general it can be stated that patients with extensive burns will require blood. Four of our patients required 8 units (500 c.c. each) of blood. Three of these soldiers had 30 per cent body surface involved and the fourth had 40 per cent involvement. However one man with 35 per cent body surface involved required only 1 unit. One soldier with only 10 per cent body surface involved required 2 transfusions but he had considerable infection of a burned forearm. The other soldier getting blood received 1 unit.

Two patients required transfusions because of secondary bleeding after dissecting off extensive eschar. Areas from which the charred skin is removed bleed very little so adequate precaution was not taken to prevent secondary bleeding. Mild pressure controlled the bleeding in both instances and the blood loss was promptly corrected by transfusion.

ANESTHESIA

In none of our patients was anesthesia used at the initial dressing. No débridement was done. Gentle cleansing of debris or street dirt was accomplished rapidly and almost painlessly whenever indicated. Coverage by sulfadiazine strips was done rapidly and the patient became comfortable with morphine, protection of burned surface and immobilization.

However all subsequent dressings were customarily done under pentothal sodium anesthesia. In patients who had only a small area of first and second degree burn, dressings were usually started without anesthesia and usually tolerated well. If much discomfort was experienced anesthesia was promptly used. All patients were premedicated before being taken to the operating room for change of dressing. Usually the period of anesthesia was limited to 1 hour but a few were kept anesthetized for 1½ hours during grafting procedures. Usually patients anesthetized by pentothal sodium early in the day were hungry for lunch by noon, and always by evening they were ready for a full diet. This diet was important in individuals who were being grafted in stages, every fourth day. Pentothal sodium has been our most satisfactory anes-

thetic and was used in over 95 per cent of patients. No patient received over 2 grams at each period of anesthesia.

Three patients had gas oxygen ether anesthesia on one or two occasions when it was planned to do a long extensive grafting procedure with 3 surgeons at work. These periods of anesthesia lasted longer than 90 minutes; there were no complications, yet recovery of appetite and vigor was slow. Usually several days elapsed before the patient would take a full diet. Whether this was due to the anesthesia or the extent of the grafts might be questioned, but on several occasions we have done extensive grafting under pentothal sodium without ill effects. We have felt therefore that for this purpose the intravenous pentothal sodium is the outstanding agent because of lack of delay in inducing anesthesia and the rapidity of recovery of the patient to accept a full diet postoperatively. We used it liberally so that no soldier need dread either the change of dressings or operative procedures.

On several occasions when recipient sites have been small we have used local novocain infiltration for the donor site but usually there were a few granulations on the recipient site to be trimmed down and some discomfort was experienced. As a result we have used local anesthesia only infrequently and only when a few small grafts have been needed.

EXERCISE

The problem of exercise or passive motion is very important in the treatment of third degree burns. In all of our first and second degree burns, bandages were removed and active motion started early enough to prevent any loss of function. Hand and finger motion in second degree burns was encouraged early. Splinting of hands was always with fingers in moderate flexion and thumb opposed. As much of the fingers as possible was left exposed and motion encouraged. When fingers were involved, either active or passive motion was used during the change of dressing.

In the third degree burns, passive motion of all joints in the involved area was exercised during the change of the dressings. Under anesthesia this was not difficult. Casts of extremities were put on with the knee in mild

flexion, elbow in 90 degrees flexion, forearm in neutral position and hand and wrist in position of function with exercise at each dressing or operation.

GENERAL NURSING CARE

The nursing problem on the wards in the present method of treatment is much different from what it was when dressings were done on the wards. All dressings, without exception, were done in the operating room under strict aseptic technique. Therefore the patient arrived on the ward as a package not to be opened. When hands were involved these patients required feeding. Frequent change of position, when possible, was encouraged. Backrubs, bathing of uninvolved areas and general hygienic care are important to these patients. Exercise of burned hands at the earliest possible moment was constantly encouraged by the ward personnel. Plasma and blood as needed were given on the wards. Rigid fly control during the summer season was supervised by the nursing staff. All in all the nursing care of the wards was no more a problem with the burn patients than for an equal number of less severe battle casualties.

Most of our patients never had an opportunity to see their own wounds or those of the other burned patients until the wounds were completely healed or covered by grafting. They were kept comfortable and their morale was good due to the excellent attention of our nursing staff. Numerous letters received from those who have returned to the United States testify to the high regard for the nurses and ward attendants.

In the operating room the change of dressings was done with the usual personnel. Dressings were usually saturated with saline after the removal of casts; the patient was anesthetized and removal of dressings was continued painlessly and easily. None of the patients dreaded going to the operating room—in fact they felt neglected if their procedure was postponed a day longer than usual.

END-RESULTS

There were 2 cases out of the 23 patients with third degree burns of the hands who developed moderate stiffness of the fingers.

Both of these patients were treated early in this series when apparently not enough attention was given to exercise. Both were returned to the United States; one required a plastic procedure and remained in the service. The other reported to us recently that he was separated from the service because of partial disability of the left hand. He secured a job in a war plant and in a letter dated approximately 10 months after his injury he stated that he had recovered almost full use of his hand and was improving. At the present time all of our patients with hands involved are watched carefully and constantly encouraged to preserve hand function. There has been no more than a mild limitation of motion at any of the other joints, all of which should return to full function promptly. In fact, with the exception of the 2 cases mentioned with hand disabilities, all the remaining patients who returned to the United States went because large areas of newly replaced skin could not be expected to function well in the wearing of military equipment or stand the rigors of reconditioning and the trauma of combat. As far as we are able to learn, only the one patient has been separated from service. There were no fatalities.

SUMMARY

In this series of 155 cases no attempt was made to keep a complete record of events for later evaluation; there was neither time nor facility for research. No control group was used—rather as changes in their management were made the previously treated patients became the control group. By the end of this series we concluded that no change need be made in accepted surgical principles. Constant improvement of method and simplification of technique should however be the aim of the doctor who is treating burns.

The treatment of burns lies in the application of surgical principles to the wounds and the wounded. The wounded patient requires comfort, warmth, rest, and supportive therapy. The wound requires cleanliness to

prevent sepsis, gentleness to prevent further trauma, coverage to prevent infection and allay irritation, support and pressure for comfort and to prevent fluid loss, immobilization for comfort and lastly and most important closure of the wound by skin in the shortest possible time to preserve the function of the deeper structures and prevent all the complications that occur in open wounds. The method used to accomplish these requirements is not too important, but any improvement of method that will hasten the accomplishment of recovery and avoid complications is a step forward. We have attempted to improve the method without evading the principle involved.

The treatment of this series of 155 burns represents the work of a group of individuals trained not as experts in the treatment of burns, but a personnel trained in the fundamental principles of management of wounds and wounded soldiers. The results have been gratifying and the following conclusions seem to be indicated.

CONCLUSIONS

- 1 Prompt, clean pressure dressing with immobilization is important in the treatment of burns.
- 2 Prompt administration of a calculated amount of plasma aids in the prevention of shock.
- 3 Infrequent dressing of burn wounds under strict aseptic conditions will help prevent infection.
- 4 Rapid skin replacement is the best method of preventing infection, deformity and dysfunction in the presence of third degree burns.
- 5 Grafts transferred directly to recipient sites adhere well and donor sites do not become infected by working directly between donor and recipient sites.
- 6 Grafts placed immediately after removal of a charred eschar will grow well.
- 7 The use of passive motion under anesthesia will help prevent deformity.

ELECTROLYTIC ABSORPTION OF BONE DUE TO THE USE OF STAINLESS STEELS OF DIFFERENT COMPOSITION FOR INTERNAL FIXATION

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IN 1941 from a comparative study of stainless steel and vitallium (Key) it was concluded that 18-8 stainless steel and 18-8 S-MO or enduro stainless steel are practically inert in the tissues and are suitable for the internal fixation of bone

It was further noted that the stainless steels mentioned exhibited a slight tendency to corrosion and that some other stainless steel nails which I had used in the past had exhibited considerable localized pitting and one Smith-Peterson nail had corroded into two pieces after over 5 years but had caused no symptoms

It was found that the vitallium nails and plates introduced by Venable and Stuck (4) exhibited even less tendency to corrosion or electrolysis in the tissues and in the solutions used in the experiments than did the stainless steels. But it was believed that the stainless steel possessed certain mechanical advantages which rendered it a more generally useful material for the internal fixation of bone than vitallium. It was stated that the Fracture Committee of the American College of Surgeons should recommend the standardization of 18-8 S-MO or enduro stainless steel for the manufacture of prostheses for the internal fixation of bone and should require such prostheses to be properly labeled in order that surgeons may know what type of stainless steel they are using. The prostheses should be passivated by the manufacturer

The introduction of noncorrosive metals into surgery has led to a considerable increase in the use of internal fixation in bone and joint surgery and a number of new prostheses have been devised. Among those which I have found useful is the Neufeld nail (2). This is a two flanged nail which is bent to form an angle

of about 135 degrees and continued downward as a slightly curved plate. It is useful in the treatment of trochanteric and subtrochanteric fractures of the femur. The two flanged nail is driven into the proximal fragment and the plate is fixed to the distal fragment with three self tapping screws.

The appropriate screws are supplied with the plate and presumably they are of the same type of stainless steel as the plate. In order that corrosion with the attendant absorption of bone from electrolysis and consequent loosening of the screws and plate may not occur they must be of the same type of steel. Unfortunately this is not always true as is shown by the femora illustrated in Figures 1, 2 and 3. Under twilight and local anesthesia these fractures of the femur, 2 trochanteric and 1 subtrochanteric, were reduced by traction and internal rotation on a Bell table and under x ray control the fragments were fixed with Neufeld nails.

The convalescences of the patients whose hips are shown in Figures 1 and 2 were uneventful except that the resorption of bone around the screws and under the plate was so marked that full weight bearing was not permitted until the Neufeld nails and screws had been removed. The cavities in the bones had partially filled in and the bone increased in density to a point where it was believed that unrestricted weight bearing could be practiced with safety. The patient whose hip is illustrated in Figure 2 complained of persistent pain and disability until the nail was removed. It is also my opinion that union of the fragments which was necessary before it was advisable to remove the nails was delayed in all 3 instances. Repeated x rays films of all 3 femora showed progressive absorption of bone around the prostheses, and as this fact was attributed to electrolysis it is believed that

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Fig. 1. Tetrochanteric fracture fixed with Neufeld nail. First operation June 20, 1944. One month after operation not marked electrolytic absorption around the distal screw and beneath the plate of the nail. On the right, the same hip is shown 2 1/4 months after removal of the nail. Note marked regeneration of bone and more firm union of fracture site.

electrolysis was responsible for the delayed union in all 3 cases.

When the plates were removed from the patients whose x rays films are shown in Figures 1 and 2 the screws were found to be corroded and loose. The wire which was used in the subtrochanteric fracture was real 18-8 stainless steel and thus had remained bright and tight. The Neufeld nails were all bright, but they were not tight and the absorption of the femoral cortex which was present beneath the plates is clearly seen in all 3 roentgenograms. The same is true of the absorption of bone around the screws. In Figure 3 a relatively large area of absorption is apparent in the cancellous bone around the proximal and distal screws and union is delayed to such a degree that even now 7 months after insertion of the nail I do not think that it is safe to remove the nail and this patient is still on crutches. In the femora shown in Figures 1 and 2 the absorption of bone around the distal screws is so marked that a pathological fracture through the previously normal bone was a definite possibility. That this was entirely

any other cause is evident from the increased strength of the bone evident in the x ray films which were taken several weeks after the Neufeld nail and screws had been removed. On the basis of these x ray films, unrestricted weight bearing was permitted and the patients seem to be getting along all right. The smallness of the bone in the patient whose x ray film is shown in Figure 2 is due to a partial paralysis of the extremity from old poliomyelitis. The nail in this patient was too long and protrudes into the acetabulum, but this caused no pain or disability. In addition to the absorption of the bone immediately adjacent to the prosthesis, there is some new bone production on the medial aspect of the shaft of the femur in the areas near the points where the screws projected and even in the soft tissues around the projecting screws in Figure 3.

That the danger of electrolytic absorption of bone after internal fixation is not limited to the Neufeld nail is shown in Figure 4. This film illustrates the right hip of a girl, 17 years of age in which the right femur was shortened 2 1/4 inches in order to equalize the length of the lower extremities. An arrest of growth had occurred in the distal epiphysis of the



Fig. 3. Subtrochanteric fracture fixed with Neufeld nail and wire. X ray films taken 5 months after operation. Not marked absorption beneath plate and around distal screws, also new bone formation on medial side of shaft. On right is postoperative x-ray film, few months after operation. Note persistent pain and disability.

opposite femur as a result of an osteomyelitis in early childhood. The postoperative convalescence was uneventful and she left the hospital 17 days after the operation walking on crutches. The hip remained painful but she had no other evidence of infection. In Figure 4 are shown x ray films of the femur 3 months after the insertion of the blade plate and 2 weeks after its removal. The films show marked absorption around the plates and screws and considerable new bone formation. It is interesting to note that the absorption of the dense cortical bone around the two lower screws is proceeding even more rapidly than is that in the cancellous bone. At the second operation the fragments were united the plate and screws were loose and there was no evidence of infection. The convalescence was uneventful and the patient left the hospital on the 14th postoperative day on crutches with instructions to bear a moderate amount of weight on the leg.

Because of the danger of progressive bone absorption from electrolysis Venable (3) has warned against the use of vitallium and stainless steel screws or plates in the same opera-



Fig. 3. Trochanteric fracture 6 months after insertion of Neufeld nail. Union not yet solid. Note marked absorption in the marrow canal around screws and beneath nail, also new bone around projecting screws on inner side of shaft. Still on crutches nail to be removed as soon as union is sufficiently advanced.



Fig. 4. Femoral shortening 3 months after fixation with Blount blade plate and 2 weeks after removal of plate. Note marked absorption especially of cortical bone around the two lower screws also marked new bone formation.

tion or even in the same bone at different operations. The cases illustrated here indicate that the danger of electrolysis perhaps is even greater when different types of stainless steel are used.

Under present conditions it is necessary for the surgeon himself to be responsible for the quality of the prostheses which he uses for the internal fixation of bone. He cannot depend upon the hospital in which he works. Figure 3 illustrates the fact that the correct length of screw is not always available. Only a few days ago while I was applying a bone plate to a tibia it was necessary to stop and check the screws in the Zimmer screw and drill rack. When purchased this rack was filled with an assortment of 18-8 S-MO stainless steel screws of uniform diameter and thread with the standard type of head. When checked on the sterile instrument table, it contained some vitallium screws and 5 different types of stainless steel screws mixed indiscriminately and the $1\frac{3}{8}$ inch screws which were appropriate for the bone in this particular operation were missing entirely their slot and an adjacent slot were filled with screws $1\frac{1}{4}$ inches long.

In addition to the heterogeneous mixture on the rack, there were probably a dozen other types of screws and plates in the operating rooms some of which were purchased in 1912

when the hospital was opened, and this hospital is not unique in this respect. Plates and screws do not deteriorate with age and as new ones are developed, they are purchased and added to the stock, but the old ones are not discarded and they are all mixed together. The average operating room nurse knows nothing of electrolysis and its effect on bone.

In the light of what is known about the deleterious effect on bone of electrolysis caused by the use of metals of different composition for internal fixation it is just as important that the metals used for internal fixation of bone be standardized as it is that drugs be of uniform purity and potency. And, when a prosthesis like the Neufeld nail which is patented and the manufacture of which is controlled is supplied with screws which are of different composition what may we expect of

prostheses which are purchased in the open market and are made by any one of a dozen or more manufacturers?

The surgeon can usually distinguish a vitallium prosthesis from one made of stainless steel unless the former is polished, but he cannot differentiate stainless steels of varying composition at the operating table. It is again suggested that only stainless steel of a uniform composition be used for all prostheses which are to be used for the internal or external skeletal fixation of bone.

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A STUDY OF THE VALUE OF LOCAL SULFATHIAZOLE IN OPERATIVE WOUNDS IN THE PROPHYLAXIS OF INFECTION

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THE power of sulfonamides when administered by mouth or by vein to inhibit the growth of certain bacteria in the human body is well established. Although this method of therapy has had spectacular success in the treatment of many infectious diseases such as lobar pneumonia it has not been effective in preventing infection in accidental or surgical wounds. This may be due in part to the fact that many of the bacteria which cause wound infections are not susceptible to sulfonamides in the concentration that can safely be maintained in the body through systemic administration. Since many of these organisms are inhibited *in vitro* by high concentrations of the sulfonamides it seemed logical to place the drugs directly in surgical and traumatic wounds. By this means a greater concentration of sulfonamide could be obtained in the wound than could possibly be achieved by systemic administration. This practice first advocated in 1936 (6 11 13 14 32) has become so popular that many surgeons routinely place sulfonamides in their operative wounds.

Strangely enough in spite of the extensive use of sulfonamides in human wounds for the purpose of preventing infection there is little published evidence to prove that the practice is of value. Many of the workers who have claimed that the local use of sulfonamides decreases the incidence of wound infection either have not employed controls or have compared a sulfonamide-treated series with a control series treated one or more years previously (3 5 12 15 19 20 26 27 29 30). This form

of comparison often leads to fallacious conclusions (22 24) because so many factors which influence the incidence of infection will vary significantly over these long periods. Those authors who have reported controlled series of cases have either reported only a small number of cases (4) or have not been able to confirm the opinion of those who believe that the sulfonamides prevent or decrease the incidence of infection when placed in operative or traumatic wounds (16 23 25 33).

If a substance is recommended for application into wounds the effects of the material on wound healing should be known. Critical evidence in regard to the effect of locally implanted sulfonamides upon wound healing is controversial. Animal experiments have shown that all the sulfonamides when implanted locally may produce an inflammatory reaction and even actual abscesses (34). It has been reported that retarded wound healing and extensive cutaneous scarring is to be expected with the local application of sulfonamides (1 9 35 36). Others concluded that delayed healing is due to excessive amounts of drug locally and stated that when used in proper amount sulfonamides in no way retard healing or result in inefficient scar formation (4 17 18 20 21). After studies on humans it was found that sulfonamides may act as irritants. It was demonstrated however that the deleterious effects are shortlived and that subsequent healing is within normal limits (28).

Because of this conflict of opinion and because of the widespread use of these drugs in wounds we undertook a study of our own to evaluate the use of sulfonamides locally as a means of preventing infection in operative wounds.

The work described in this paper was done under a contract, recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and Wayne University.

From the Department of Surgery, Wayne University College of Medicine, and the Division of Surgery, Detroit Receiving Hospital.

TABLE I.—CLEAN WOUNDS

Bone operations	27
Minor surgical cases	99
Herniorrhaphies	74
Laparotomies	70
Total	270

MATERIALS AND METHODS

Sulfathiazole was selected as the sulfonamide which according to theoretical considerations would be most likely to be effective in preventing infection. Two preparations were employed: sulfathiazole powder and a 20 per cent suspension of microcrystalline sulfathiazole in saline (5 7 8 31). The powder was sterilized before use by dry heat at 140 degrees Centigrade for 1 hour. The microcrystalline form was used as supplied by the manufacturer. All of the wounds were closed without drainage. Sulfathiazole was never packed in a wound but a quantity just sufficient to frost the surfaces was spread evenly throughout the wound just before closure. Care was taken not to place sulfathiazole between the skin edges.

The patients who were all admitted to one of the surgical services at the City of Detroit Receiving Hospital were followed personally by the authors from the time of operation until wound healing was complete. Frequent inspections of the wounds were made; cultures were taken of any exudate; and the condition of the wound was noted and recorded on special summary sheets.

For purposes of study the series of 576 patients was divided into two main groups—patients with clean surgical wounds, and patients with contaminated wounds.

A clean wound was defined as one made deliberately by the surgeon and not contaminated during the operation by a bacteria laden material such as saliva, feces, or pus. The contaminated wounds were either traumatic wounds or operative wounds which were con-

TABLE II.—CONTAMINATED WOUNDS

Traumatic	126
Appendectomies	73
Perforated ulcers	31
Gastric resections	30
Bowel operations	21
Miscellaneous	1
Total	283

taminated with infectious material during the operative procedure. Only traumatic wounds made with a sharp object and which could be debrided and readily closed without tension were included in the series. Subdivisions were made in each of the groups in order to make the wounds as comparable as possible. Patients in each of the subdivisions were alternated as drug treated or controls.

The subdivisions of the clean wounds were (1) wounds made for open reduction of fractures (2) minor surgical procedures, such as lymph node biopsy (3) wounds made for herniorrhaphies (4) wounds for laparotomies. The subdivisions of the contaminated operative cases were (1) wounds made to repair perforated peptic ulcers (2) wounds made for removal of acutely inflamed appendices (3) wounds made for gastric resection (4) wounds made for operation on the intestine and (5) a miscellaneous group.

About 90 per cent of the operations were performed by 6 surgeons of the resident staff. The skin preparation, type of incision, and suture material were constant for each procedure.

Except for 14 patients who had sulfonamide therapy systemically because of pulmonary complications, none of the patients received any chemotherapy other than sulfathiazole in the wound. None of these 14 patients developed infected wounds.

RESULTS

The distribution of the cases is shown in Tables I and II.

TABLE III.—CLEAN WOUNDS

Drug	No. of cases	Infections	Per cent wound infections
+	28	5	18

TABLE IV.—CONTAMINATED WOUNDS

Drug	No. of cases	Infections	Per cent wound infections
+	26	14	54

Table III compares the incidence of infection in the clean wounds which were treated with sulfathiazole with those which received no drug. Five infections occurred in 128 drug treated patients making an incidence of 3.9 per cent while only 3 occurred in 142 patients who received no drug, an incidence of 2.1 per cent. The incidence of infection in the two groups is almost identical.

A comparison of the contaminated wounds is shown in Table IV. In this series the incidence of infection in the patients who received sulfathiazole is less and it appears as though the drug exerted a beneficial effect. However this difference is not statistically significant (2/10).¹

The wounds in which sulfathiazole had been placed were more indurated than the control wounds and there was a higher incidence of hematoma in the drug treated group. These figures are given in Table V. Wound separation was rare but occurred more often when the drug was not used locally.

Periodic tabulation of the cases and tabulation according to each surgeon demonstrated that the figures given in the tables were consistent throughout the study.

The organisms which caused most of the infections were *Staphylococcus aureus*, alpha beta and gamma hemolytic streptococci and *Escherichia coli* alone or in combinations.

No definite evidence was produced to show that there was any difference in the effect of suspension of microcrystalline sulfathiazole or macrocrystalline powder.

EVALUATION OF STUDY

The statistics obtained from this study are reliable because the control series is comparable with the treated series. By classifying the patients into the various groups there tends to be only one important varying factor—whether or not sulfathiazole was used as local implantation in the wound before closure. There was no selection of cases for use of the drug. These are parallel alternating unselected controls.

Sulfathiazole when used locally in operative wounds just before closure caused an increase

TABLE V—WOUND COMPLICATIONS OTHER THAN INFECTION

Type of case	Drug	N. of cases	Increased induration	Hematoma	Total	Complications per cent
Clean	+	128	0	6	5	3.9
Clean	-	142	7	3		7.0
Contaminated	+	50	6		8	1.5
Contaminated	-	50		3	3	8.6
Total	+	184	13	8	43	5.1
Total	-	202	7	6	23	7.9

in the incidence of wound complications notably increased induration with possibly delayed healing.

In heavily contaminated wounds sulfathiazole used locally seemed to decrease the incidence of infection but did not eliminate it. In clean wounds the incidence was not appreciably affected. The explanation of this divergence may be that in clean wounds there are not many bacteria and the incidence of infection is usually low. Here the foreign body reaction of the drug and its tendency to hematoma formation overshadow its antibacterial effect. In the contaminated wounds there are more bacteria and the natural incidence of infection is higher. Here the antibacterial effect of sulfathiazole is more important than its irritating effect on the wound and it decreases the incidence of infection. This treatment, however, is far from satisfactory as the incidence of wound infection is still 9 per cent. Furthermore applying the principles of statistical methods the difference in percentages of wound infections in the treated and control series even in the contaminated cases is not statistically significant and may be due merely to chance. Accepting this concept we could reconcile the findings in the clean and contaminated series. That is, there is no appreciable change in the incidence of wound infection brought about by using sulfathiazole prophylactically.

CONCLUSIONS

One can conclude from these results that sulfathiazole used locally in wounds does not prevent wound infection. There are several reasons for this conclusion.

¹The statistical significance of the results were checked by Dr. Henry H. Bailey of the department of mathematics, College of Liberal Arts of Wayne University.

1 The organisms which cause wound infection are not very susceptible to the sulfonamides.

2 Dead tissue and foreign bodies which are of necessity present to some extent in any wound, inhibit the action of sulfonamides.

3 Sulfathiazole leads to increased bleeding and hematoma formation a factor known to predispose to infection.

These disadvantages together with their proved inability to prevent wound infection should lead us to seek other means of decreasing the incidence of infection in surgical wounds.

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VASOEPIDIDYMAL ANASTOMOSIS BY PRODUCTION OF PERMANENT FISTULA WITH USE OF STAINLESS STEEL WIRE

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AZOOSPERMIA as a cause of sterility in barren marriages is a common finding. Hotchkiss (4) found that 18.6 per cent of the men in his series of 100 in fertile marriages showed no spermatozoa in the semen. In my series of infertile couples 13.3 per cent of the men had no spermatozoa in their semen while in those couples in which the husband was either a contributing or a sole factor of the infertility the incidence of azoospermia was 26 per cent.

(The absence of spermatozoa in the semen may be due either to failure of the testes to produce sperm or to blockage of the efferent ductal systems so that spermatozoa cannot pass into the semen. The etiology of this condition is often obscure. I was unable to determine it in 65 per cent of my cases.)

(The globus minor of the epididymis and the adjacent portion of the vas are the commonest locations for the obstructive type of lesion. Pre-existing localized inflammations probably account for the majority though severe trauma is not an uncommon cause. Bothe and Robinson have described congenital strictures which if bilateral would cause azoospermia.)

Gonorrhea is the specific disease which has most frequently been shown to be a cause of the obstructive lesion. Of course such an infection must usually effect a bilateral blockage of the efferent ducts to produce an azoospermia. However it is well to bear in mind that unilateral blockage can cause the same changes in the semen as that of bilateral lesions, if the opposite testicle is atrophic. Nonfunctioning spermatogenic tissue is a common sequela of cryptorchidism or mumps orchitis and occasionally follows severe trauma to the testis. Unilateral testicular atrophy together with contralateral blockage of the epididymis or vas will result in azoospermia.

It is worthy of note that the gonococcus never attacks the epididymis of an atrophic

testicle. At least the author has not seen this occur nor has any reference to it been noted in the literature.

Remedial therapy of sterility due to blockage of the epididymides or vasa or both, has as its objective the re-establishment of the patency of the ductal passageways and the subsequent liberation of the imprisoned spermatozoa. In 1902 Martin devised an operation to accomplish this end. He united the vas with the epididymis using silver wire sutures thereby establishing an anastomosis of the patent sections of each and bypassed the occluded areas. Hagner (2,3) pursued Martin's technique of vasoepididymal anastomosis and was able to report cures in 58 per cent of the cases in which the anastomosis was performed. Humphrey and Hotchkiss employed fine arterial silk as suture material. Hotchkiss (5) states: "Successful results should reach about 20 per cent of those operated upon and yet the failures are no worse off than prior to operation. Nevertheless most urologists have had so many failures with the Martin-Hagner method that commonly the sterile patient is advised against submitting to any surgical treatment."

Recently the author has devised and performed an operation for vasoepididymal anastomosis which appears to promise better chances for successful results. This operation is a modification of the Hagner-Martin method and introduces a new principle in that a permanent fistula is produced between the lumen of the vas and the globus major of the epididymis. This is accomplished by means of stainless steel wires¹ which are in

¹The use of stainless steel wire as the least irritating foreign material both for sutures and for the production of the fistula, was suggested by Dr. Sterling Bunnell. Hotchkiss (5) suggests that nickel-iron wire may be used for the anastomosing material. He records that Dr. J. H. Draper has demonstrated that either silver or nickel-iron wire may remain in the lumen of the ductus deferens of the dog for months without causing inflammatory reaction or foreign body response.

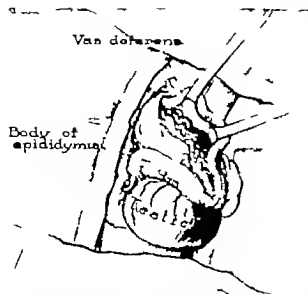


Fig. 1. The testis, epididymis, and cord have been delivered from the scrotal sac. The vas has been isolated and held up by umbilical tape. In this and the following illustrations the vas and epididymis have been drawn disproportionately large.

sorted into the lumen of the vas through the incision for the anastomosis, passed upward in the lumen and out through its anterior wall then brought out through the skin of the scrotum where the ends are fixed with shot. The lower ends of the wires are passed through the window cut in the globus major for the anastomosis and out the opposite side of this organ. They are then passed through the tunica vaginalis and the skin of the scrotum below the incision and fixed with shot. These wires are removed in 10 to 14 days. The steps of the operation are given in the following description.

Spinal anesthesia is the method of choice.

The scrotum and pubic region are prepared as for any intrascrotal operation. A longitudinal incision 5 to 6 centimeters long is made on the lateral anterior surface of the skin of the scrotum. The underlying layers of the muscle and fascia are incised, the tunica vaginalis is opened and the testis, epididymis, and adjoining portions of the cord including the vas, are delivered (Fig. 1).

The testis and epididymis should be examined for any gross pathology. The vas is isolated and a convenient point is selected for anastomosis with the globus major of the

epididymis. An oblique incision is then made across its anterior wall to expose the lumen. A dilute solution of methylene blue is injected into the terminal segment. A free flow of fluid will indicate that no obstruction exists distal to this point. A slight blockage might be overcome by the introduction of a strand of silkworm gut into the vas, thereby subsequently permitting the fluid to pass by the occluded point. If found obstructed at one site it may be possible to perform the operation at a slightly higher level. Upon establishing proof of patency the incision is then extended longitudinally and its margins are trimmed so that an oval window about 0.5 centimeter long is produced (Fig. 2). Attention is now turned to the epididymis, and an oval opening of approximately the same size is cut out of the lateral superior portion of the globus major of the epididymis (Fig. 3 C). The secretions from the excised tubule are immediately examined microscopically for spermatozoa. It is encouraging to demonstrate them in the epididymis at the point selected for anastomosis but the operation should not be abandoned if none is to be

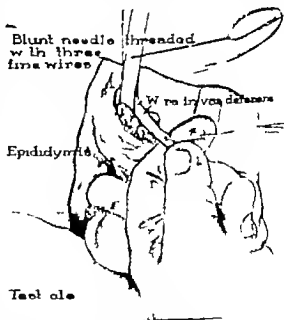


Fig. 2. A small incision has been made in the vas, and it has been enlarged and made oval in shape. Three wires threaded on blunt ended needle have been passed through the incision, up the lumen of the vas and out through its wall.

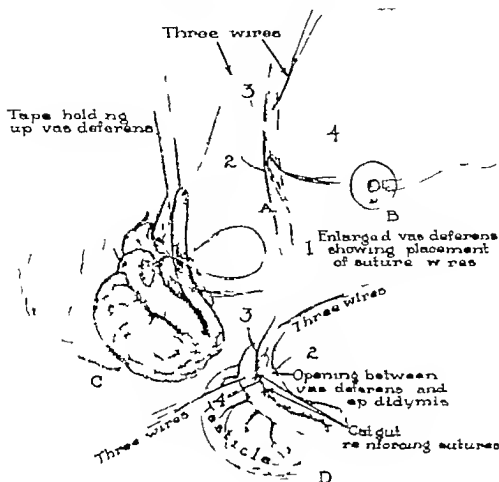


Fig. 3. A The group of three wires has been passed through the oval incision in the vas, up the lumen of the vas, and out through its wall. The four wire sutures (1, 3, 3, 4) to make the anastomosis are shown. B Diagrammatic cross section through the vas showing depth of anastomotic suture wires in its wall. C, The oval fenestra has been cut in the globus major. The needle carrying the fistula wires from the vas has partly been passed through the globus major. D The anastomosis between the vas deferens and epididymis has been completed. The three wires which temporarily maintain the fistula are shown. Their course is indicated by the dotted line. The four anastomotic suture wires have been passed and tied. Three of them have not been cut and are shown.

found. This policy is substantiated by precisely such an experience on one occasion. Although a smear from the epididymis was negative a biopsy of the testis secured at the time of operation revealed spermatozoa to be present in the seminiferous tubules and ultimately they appeared in the semen when it was examined after recovery from the operation (Fig 5 a, b).

A blunt nosed straight cambric needle threaded with three stainless steel wires (No 36 20 to 25 cm long) is then passed up the lumen of the vas for a distance of about 2.5 to 3.0 centimeters and then carefully pushed through its wall (Fig 2). The needle is removed

and the wires are threaded on a cutting skin needle. The lower ends of these three fistula producing wires are then threaded on a suitable size Ferguson needle and passed through the window cut in the globus major and out the other side of the epididymis (Fig 3 C). The wires are then threaded on a curved skin needle and left loose. At the margins of the incision in the vas four stainless steel wire sutures (40) are passed through its wall, but not into the lumen (Fig 3 A B). One each at the superior and inferior angle of the incision and one each midway laterally. These sutures are then passed through the tunica vaginalis, and several loops of the epididymal

Fistula wires and shot
to be removed later

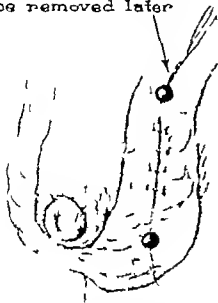


Fig. 4. The operative wound in the scrotum has been closed. The mattress sutures are not shown. The ends of the group of the three fistula maintaining wires have been brought out through the scrotal skin and are held in place by shot. These wires are removed to 4 days post-operative.

tubule at corresponding points on edges of the window already cut in the globus major. The inferior and posterior lateral sutures should be approximated and tied first, then the upper and anterior lateral sutures. One or two sutures of catgut fix the vas to the epididymis about 0.5 cm. to 1.0 centimeter below the anastomosis (Fig. 3 D). The testis and other structures are then returned to the scrotum.

The lower ends of the fistula-producing wires which have been threaded on a skin needle are passed through the tunica vaginalis and the skin of the scrotum about 2.0 centimeters below the end of the incision in the scrotum. Similarly the upper ends of these wires are passed about 2.0 centimeters above the upper end of the scrotal incision. The tunica vaginalis is sutured with catgut after first the introduction of an exploring finger to make sure that the organs are in proper position. The incision is closed with deep mattress sutures of silk worm gut and the skin with a running catgut suture. Before the incision is closed it is advisable to measure on the wires where the shot should be applied so that there will be no tension. Following the closure of the skin incision both the lower and upper ends of the wires are shot separately (Fig. 4). Tincture of benzoin com-



Fig. 5. Biopsy of testis. Case of azoospermia, 41 years. a, left, Low power. b, right, High power. Normal testicular tissue. The very small black bodies (tubules) are spermatozoa. Spermatozoa absent in smear from

epididymus 1 time of operation. Active spermatozoa present in ejaculated semen specimens which are taken during postoperative period of 1 to 7 months (last examination).

pound gauze and a large sized suspensory are applied with plenty of gauze for pressure.

The fistula wires are removed in 10 to 14 days without any difficulty. Convalescence in all cases has been uneventful.

The patients have had no serious pain and no complications have occurred. The swelling of the soft tissues remains 3 to 6 weeks. After 3 to 4 weeks the site of the anastomosis can be felt as an indurated mass about 2.5 to 3.0 centimeters in length and about 1.0 centimeter in width. This mass gradually subsides until in from 2 to 4 months it shrinks to a small hard body about 1.5 by 0.6 centimeter. There is very slight tenderness on pressure and the patient experiences very little if any discomfort after the first couple of weeks.

With the exception of this area of anastomosis in all cases the testes, epididymides and vasa appear grossly normal. As there has been no occasion to explore the patients operated upon, no microscopical examination has been possible. In experiments upon dogs the author found no changes in the testes although small fibrotic areas were found in the globus major with fibrotic occlusion of the vas at the anastomotic area.

[This operation has been employed in 5 cases of azoospermia due to blockage of the ductal systems. The gonococcus had been the primary causative agent in 4 cases whereas the fifth was traumatic in origin. Bilateral occlusion was present in 4 while the fifth had unilateral testicular atrophy with occlusion of the epididymis on the opposite side.]

The operation was completed on both sides upon 2 of the men and in the remainder the anastomosis was done on one side only.


Spermatozoa have been found in the semen following operation in 2 of the cases. Atrophy of one testicle precluded the performance of a bilateral anastomosis in one of these patients. There has been one pregnancy.

The types of cases which have failed to demonstrate spermatozoa in the semen are as

follows. The number of weeks postoperative that the semen was last examined is given.


Type 1 Patient suffered from postgonococcal bilateral vasoeepididymitis. Operation was performed November 7, 1944. Bilateral anastomosis was done. Semen was last examined 3 weeks after operation.

Type 2 Patient suffered from postgonococcal bilateral vasoeepididymitis with unilateral complete occlusion of vas. Operation was performed January 30, 1945. Unilateral anastomosis was done. Semen last examined 11 weeks after operation.

Type 3 Patient suffered from post-traumatic bilateral occlusion. Operation was performed October 31, 1944. Unilateral anastomosis was done. Semen was examined 16 weeks after operation. 

Spermatozoa may appear in the semen any time up to the twelfth postoperative month and therefore the procedure cannot be completely evaluated until 1 year has passed.

SUMMARY

Five cases of azoospermia due to blockage of the ducts of the vas and epididymis are herein reported. A new operation is suggested in which stainless steel wires are interposed in the fenestra of the vasoeepididymal anastomosis to further the development of a permanent fistula between these two structures. The series of cases is small but the percentage of successes is comparatively high. With further development of the technique it is hoped that more favorable results may be achieved. 

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THE TREATMENT OF VARICOSE VEINS

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GROWING experience with varicose veins of the legs gives rise to more accurate understanding of this condition and makes possible the expansion and refinement of therapy. The treatment of 200 private patients seen since January 1943, forms the basis of this paper. All the details of diagnosis, treatment, and follow up have been carried out by me. It is my belief that this continuity of supervision tends to give the best results. Most clinics have to overcome the difficulty of insufficient personnel and an ever changing house staff. In addition since their clientele is from the lower income groups the staffs must constantly surmount ignorance, poor hygiene, and lack of co-operation. To a large extent these factors can be discounted in the present study.

Many of these patients present a superficial sameness which not only dulls interest but stifles critical appraisal. One can only say that careful examination and choice of treatment bring gratifying results.

ANATOMICAL

There are three vein systems in the leg (6) (a) the short or external or lesser saphenous, (b) the long or internal or greater saphenous, (c) the femoral or deep circulation. There is also a variable network of superficial veins, particularly about the knee, thigh and buttocks which can become varicose under certain conditions. These varicosities are not always associated with valvular deficiencies; hence, in certain cases, saphenous ligation is not indicated.

PATHOGENESIS

Absence of valves. Studies in cadavers by Eger and Casper showed absence of valves in the external iliac and femoral veins proximal to the orifice of the saphenous in 36.8 per cent of cases. In this series one or both sides were deficient in valves, the left side approximately twice as often as the right. No attempt was made to correlate valve deficiency to the presence of varicosities. The conclusion that on an anatomic basis there is a 36.8 per cent minimal potential incidence of varicose veins of the lower extremities is an interesting hypothesis.

Valve incompetency. Routine tests for valve competency are applicable to any segment of vein one wishes to study. They do not permit distinc-

tion between developmental absence and acquired deficiency. It seems reasonable to assume that normal veins subjected to continued abnormal stress could be dilated to a point where the valves no longer close. This frequently happens in individuals following femoral phlebotomies when the superficial veins serve as dilated collaterals. Once the valve rings are stretched, incompetency increases, even after recanalization of the thrombosed vessels. Occasionally, however, I have found valve incompetency in the perforating veins—blowouts—which disappeared following bedrest and elevation only to return on prolonged unsupported standing. The moral of this is to examine thoroughly for "blowouts" when the patient is first seen. At this time the veins are usually biggest and the maximum number of "blowouts" can be discovered and marked for excision.

Valve incompetency exists most often at the greater saphenofemoral junction—making necessary the classical saphenous ligation. Usually this incompetency exists when the greater saphenous system is varicose. Occasionally the saphenous vein at operation is small and normal in appearance. In such cases there is usually a "blowout" farther down the thigh—sometimes only 2 or 3 inches below the saphenous bulb.

Another frequent point of incompetence is at the orifice of the lesser saphenous vein. This condition may exist by itself or be associated with greater saphenous varices. Incompetent valves in the perforating veins usually do not exist without one of the valvular defects above noted.

Venous pressure in standing individuals is the same in "normal" as in varicose veins (5). It corresponds roughly to the hydrostatic pressure of the blood column leading to the heart. In the recumbent position, in both antecubital and saphenous veins, pressures are elevated in patients with large varicosities. This is probably due to increased blood volume caused by partial emptying of the capacious varicose reservoir. The abnormality is corrected by proper treatment. Orthopnea in patients with mild degrees of heart disease is frequently relieved by proper attention to varicosities.

When the veins are full, as in the erect posture, blood flow in varicosities is upward, although slowly as can be shown by venography. The



Fig. 1. a, Deficient vascular type showing bodily configuration. Note irregular mottled skin. b, Same patient. There are varicosities of the right greater saphenous system. c, On the left side the varicosities arise from a "blowout" in the upper posterior thigh. Neither saphenous system is involved. Note telangiectasia about ankles.

idea that blood flows out of the fossa ovalis and down the saphenous vein is erroneous and implies a pressure differential that does not exist. In normal veins the flow is rapid because of (1) the smaller caliber and (2) muscle action. The latter compresses a vein segment between two valves, blood flows through the upper valve which closes when compression ceases and the segment again fills from below. When valves do not function this progression is not maintained and the blood stagnates (Fig. 2).

Constitutional factors. Empirical observations allow the segregation of some of these patients into groups according to body type. (a) *A deficient vascular group* (Fig. 1). In this group there is extensive superficial venous dilatation manifested by capillary hemangiomas, telangiectases and a multitude of small varicosities. The legs are usually large out of proportion to the rest of the body. Sometimes there is immense adiposity of the buttocks, thighs, and legs suggesting glandular dysfunction. The larger vessels when exposed at operation are thin walled and tremendously dilated. There may be sacular bulges up to 4 or 5 centimeters in diameter. There may be associated hemorrhoids or vulvar varicosities. The overlying skin is irregular and mottled, becoming

easily discolored. I have seen this type more often in females but frequently in males of the Froehlich habitus. Treatment is apt to be prolonged, difficult, and unsatisfactory. (b) *A type apparently deficient in connective tissue* (Fig. 3). This individual is usually male, lean, muscular of athletic type with a long spare build. In him varices appear in early adult life and gradually enlarge through the years. He has little sub-

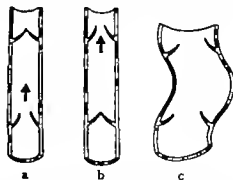


Fig. 2. a, Normal segment of vein between two competent valves. Upper valve closed, supporting blood column while segment fills from below. b, Normal vein segment. Muscle action compresses segment partially emptying it, lower valve holds it tight. c, Varicose segment. Valves incompetent. Muscle action can force blood in either direction. Upward flow not accelerated.



Fig. 3. a, Type decidant in connective tissue. Long, spare build. Bilateral enlarged external inguinal rings. Small left direct inguinal hernia. Small right varicocele. b, Same patient. Saphenous enlarged from groin to internal malleolus. No other varices. Other leg normal.

cutaneous fat so that all his veins are prominent. He may have an associated varicocele and is subject to inguinal hernia. Telangiectasia and pigmentations are uncommon. Treatment is more easily carried out and results are generally good. (c) *Congenital venous abnormalities*. These enlarged veins may be associated with other stigmas such as extensive hemangiomas. They are characterized by abnormal vascular connections and extensive valve deficiency. I have seen a patient with the entire right lower extremity covered with capillary hemangiomas extending onto the abdomen and buttocks. The enormously dilated right saphenous vein passed over the right fossa ovalis across the pubes and drained into the left femoral through the left fossa ovalis. There were numerous free connections between the abnormal vein and the right femoral vein. This type of varicosity is evident at birth or at a very early age.

DIAGNOSIS

The first step is to decide which venous systems are involved. According to Larson and Smith the lesser saphenous valve was incompetent in 7 per

cent of 491 cases. Obviously if this is the only venous abnormality other ligations are not necessary. A large vein or veins appear in the popliteal space near the flexion crease, and the associated varices involve the calf and ankle. If there is incompetence of the saphenofemoral valve, the greater saphenous vein is usually enlarged and may be palpable throughout its course down the inner aspect of the thigh behind the internal condyle of the femur ending in varices involving the medial and anterior part of the calf and leg. In very stout people it is difficult to locate the veins accurately. If there is doubt on this score, the greater saphenous vein should be ligated as a matter of routine. It may appear that neither vein pattern exists. In this case two situations may be present either (1) there is no incompetence in the connections between the superficial and deep veins, or (2) there are isolated incompetent 'perforators'. In the first instance no ligations are necessary and in the second, routine saphenous ligation is useless. The 'perforator' itself must be located and excised.

The patient to be tested for competence of the saphenofemoral valve rests supine with the leg elevated. Gentle massage in a proximal direction will hasten emptying of the veins. A tourniquet is applied high on the thigh firmly but not tightly enough to obliterate arterial pulsations. The patient then stands immediately. If the entire system of varices remains empty and then begins to fill slowly from below one can assume there are no 'blowouts'. The tourniquet is removed. If the veins then fill rapidly from above incompetence of the saphenofemoral valve is demonstrated. (Note: This down flow of blood ceases when the venous reservoir is filled. The blood then flows slowly upward.)

If during the test described the veins fill rapidly while the tourniquet is in place it is presumed that there is a 'blowout' present. The level of the early influx of blood will give a clue to its location. To locate 'blowouts' Pratt devised the following:

An Ace bandage is applied from the toes to the groin and a tourniquet placed on the thigh above this area. As the bandage is removed, a sudden protrusion of a collection of veins shows the point of incompetence. A second Ace bandage, which may be wrapped from above down, exposes only a small area at a time and is helpful (Fig. 4). This is easily and quickly done. I believe, however that the lower Ace bandage keeps the varices only partly empty, that, as it is unrolled, blood fills the visible portion of vein and that the blood may have come from below and not necessarily via a 'blowout'.

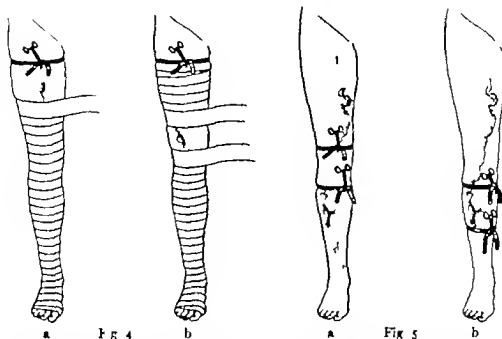


Fig 4. a and b Method of locating multiple blowouts using a tourniquet and two elastic bandages, (after Pratt)

Fig 5. a, The leg has been elevated, thus emptying the veins, and a segment of vein isolated between tourniquets. The segment has remained empty in the erect position indicating an absence of blowouts in this segment. b, Test repeated with tourniquets reapplied lower down. Segment has rapidly filled indicating presence of blowout. Note Veins below lower tourniquet remain empty indicating absence of blowouts.

To locate these 'blowouts' more exactly and to prevent the upward reflux from giving false positive tests for 'blowouts' I make repeated application of the tourniquet at different levels emptying the veins by elevating the leg between each application. The presence of a suspected 'blowout' in any vein segment can be readily detected by using two tourniquets (Fig 5). The vein is emptied and a tourniquet is applied on either side of the suspected site. If the isolated segment fills there is a 'blowout' somewhere between the constrictions. By repeating the procedure shifting the tourniquets the 'blowout' can be accurately located and marked.

Measurements As a routine I measure both legs, selecting arbitrary points of reference. The ankles are measured at their slenderest level, the calves and thighs at a point 15 centimeters below and above the upper margin of the patella, respectively. Accurate comparison can be made later.

Pertkes test This test is based on artificial occlusion of the superficial venous return by a tourniquet placed around the upper thigh. The patient then walks for 5 minutes. If the deep venous circulation is blocked the leg becomes congested swells, and is uncomfortable. This means that the superficial veins, both varicose and normal, are acting as collaterals. In this in-

stance saphenous ligation is deferred until recanalization of the deep veins has occurred.

Tests for arterial disease The dorsalis pedis and posterior tibial arteries are palpated as a routine. If these pulses are full the arterial circulation is considered to be adequate. If palpation is difficult or impossible the arterial circulation may be normal since these vessels may show wide variations in caliber and location. Oscillometric readings are then done as an aid in determining the degree of arterial pulsation. The oscilometer should be used of course, in all cases in which there is a history of claudication abnormally cold extremities or other history suggestive of arterial insufficiency.

Varicoseities due to valve incompetence are treated by surgery even in the presence of advanced arterial insufficiency. Saphenous ligation with eradication of incompetent perforators is carefully done. Sclerosis is never attempted in the presence of arterial disease. Ace bandages are not worn postoperatively but rather all efforts are made to promote vasodilatation during the post-operative state. These measures include use of (1) a thermostatic heat cradle (2) alcohol by mouth (3) other vasodilators such as typhoid vaccine or depropanex, (4) mecholyl iontophoresis, (5) lumbar sympathetic novocain nerve block.

Laboratory data. *Erythrocyte sedimentation rate.* This is a valuable index of phlebotic activity. It should always be done if a history is obtained suggesting deep or superficial thrombophlebitis. Elevation of the rate may cause one to defer operation and certainly contraindicates the use of sclerotics.

Blood count. Certain patients have multiple episodes of thrombosis on the basis of polycythemia. Measures to bring the red cell count to normal should be taken before surgical intervention is undertaken.

X-rays. Venography has given valuable information regarding blood flow in varicose veins but has a limited application. It is valuable in demonstrating deep venous occlusion and may help to estimate some congenital anomalies. At best it serves only to confirm the clinical findings.

TREATMENT

Nonoperative Cases

If no valve deficiency can be demonstrated or inferred, it is useless to interrupt surgically any of the veins, varicose or normal. The cases falling into the nonoperative group show scattered, wandering varicos of the superficial type, usually of medium caliber but frequently in smaller veins and associated with telangiectasia. They are unsightly but rarely cause secondary effects, such as edema or ulceration. The treatment is by injection of a sclerotic. I use sodium morrhuate 5 per cent with benzyl alcohol as a routine and sodium ricinoleate 3½ per cent as an alternative in the rare case which shows sensitivity to the morrhuate. All patients should be given a preliminary test injection of 0.3 cubic centimeter of the sclerosing substance at the first visit. This injection is introduced into one of the varices and usually causes no reaction whatsoever. Very occasionally generalized urticaria results and even asthmatic symptoms develop. This situation should respond to an injection of adrenalin followed by ephedrine orally. I have never seen a true anaphylaxis. In two patients sensitivity developed to the morrhuate compound after a course of injections followed by 4 to 6 weeks rest periods. The injections were discontinued because of mild delayed urticaria. Ethylamineoleate has been tried but its effect seems less predictable and the sclerosis less firm and extensive than that from the morrhuate.

Injection is accomplished with a fine sharp No. 27 hypodermic needle. The patient stands—on a table with hand rails—so that the site of injection is roughly at the surgeon's eye-level. The light should strike the leg tangentially so as to fill

houette the vessel. The syringe is held in one hand so that aspiration can be made when desired without changing the grip. Usually if the syringe is held downward, blood will flow into the solution without aspiration. The other hand serves to steady the tissues during the venopuncture. When one of these varices is excessively large, it must be emptied before injection is made. Too much blood dilutes the sclerosing agent, nullifying its effect. An excessively large clot forms, is painful, unsightly and disappears slowly. To prevent this clot formation the leg is elevated after insertion of the needle and the vein is emptied before injection is begun. Sometimes this maneuver is difficult. When this difficulty arises, the patient lies supine and the veins are distended with the aid of a tourniquet which is removed after insertion of the needle.

From 10 to 20 cubic centimeters of solution are injected, depending on the size of the vein and the individual's reactivity. The latter varies considerably. The site of injection is compressed with alcohol soaked cotton wispas used for sterilization and maintained in position with two 4 or 5 inch strips of adhesive 1 inch wide. The length of vein sclerosed per injection is enhanced by the wearing of an Ace type bandage for 2 or 3 days. The bandaging keeps the sclerotic from "puddling" and spreads it along the vein while preventing influx of new blood. If this type of bandage is objected to a 4 inch square of cotton 1 inch thick applied over the injected area and bandaged into place for 48 to 72 hours may be less unsightly. Injections are usually made at weekly intervals. Sometimes four injections totalling 40 cubic centimeters are made in one sitting and are well tolerated.

Occasionally *palliative treatment* is the only sensible course. Operation is contraindicated sometimes by extreme age and often by other more serious illness. Measures taken include: (1) Ace bandages. These are put on before arising in the morning. For long continued use Ace type bandages, flesh colored, with elastic threads interwoven in 3 or 4 inch widths are most satisfactory. (2) If edema permits periods of elevation during the day and continuously at night are scheduled. (3) If there is a tendency to infection daily hot saline soaks are instituted. Should there be evidence of a fungous dermatitis, warm potassium permanganate soaks 1:5000 are applied, daily at first, then alternately with the saline soaks, and finally at weekly or other intervals sufficient to control the situation. (4) Dressings for ulcerations usually are made with some bland ointment. I have no routine and often one must find the best applica-

tion by trial and error. Frequently, a plain dry dressing is the best, and this is soaked off daily. I have tried the various sulfa ointments, such as Vitamin A and D ointment, chlorophyll ointment and others, and have found nothing for average use better than boric acid ointment. (5) *Weight reduction* in the presence of extreme obesity is important.

Operative Cases

Preoperative care is directed toward (1) *reduction of edema* and (2) *elimination of infection*. Generally the wearing of an Ace type of bandage with periods of elevation during the day and at night will suffice to reduce edema. For the most severe cases 1 to 2 weeks in bed at home may be necessary. It is hard to get co-operation from some individuals so that it may be necessary to admit them to the hospital 4 to 7 days preoperatively for close supervision. Hot saline soaks for infected ulcerations are carried out daily with appropriate dressings. These can be augmented by potassium permanganate 1:5000 soaks should fungous infection be present. In stout people weight reduction is begun immediately. The obese often have a troublesome groin intertrigo which must be cleared up before operation can be safely done. Frequent baths are followed by thorough drying sprinkling with thymol iodide powder and the insertion of gauze between the skin folds to keep the area dry. In cases of acute saphenous thrombophlebitis in which early ligation is to be done, it is my custom to give sulfadiazine several days before and after operation. This step is rarely necessary following femoral thrombophlebitis because the time lapse between acute infection and operation is sufficiently long (6 to 12 months) for infection to subside. If sclerosis is to be done, a preliminary test injection of 0.3 cubic centimeter of sodium ricinoleate is made into a suitable varix.

The patient is admitted to the hospital the evening before operation. For high saphenous and 'blowout' ligations the skin is shaved from toes to umbilicus and a low enema is given. Nembutal 1½ or 3 grains is given for sleep and repeated the following morning 1½ hours before operation. Morphine sulfate 1/6 grain and scopolamine 1/150 grain are given 45 minutes before operation. Most patients will then sleep soundly during the operative procedure. Immediately before the patient lies on the table the location of 'blowouts' is checked and the actual lines of incision marked heavily with indelible pencil.

Choice of operation Patients showing incompetence of the saphenofemoral valve should have

a *high saphenous ligation* with division of all tributaries. Incompetent perforators should be excised. *Retrograde sclerosis* after the method of Pratt is done in uncomplicated cases. Sclerosis is contraindicated (1) following acute saphenous thrombophlebitis (2) in the presence of vaso-spastic disease of the lower extremities—painful moist postphlebotic extremities with or without ulceration react unfavorably and sometimes alarmingly to sclerosis—(3) in the presence of obliterative or other peripheral vascular disease as for example, arteriosclerosis or thromboangitis obliterans, (4) following abnormal reactions to the test dose such as urticaria, asthma, severe local pain or inflammatory reaction.

If the saphenofemoral valve is intact it is only necessary to excise any 'blowouts' which may be present or to ligate the lesser saphenous vein at its termination. I also excise many extremely dilated segments as these are obliterated with difficulty and may break down following retrograde sclerosis. If the saphenous vein is dilated through out, I usually interrupt it just below or just above the knee even in the absence of 'blowouts'. This lessens the tendency to recanalization of thrombosed varices in the calf and leg.

Operative technique Shoulder pieces are installed so that moderate Trendelenburg position can be used if desired. Many large varices remain distended when the patient is in the flat position. This distention is undesirable if retrograde sclerosis is contemplated. The excess blood dilutes and 'puddles' the sclerotic and causes excessive clot formation. About 10 or 15 degrees of Trendelenburg position is sufficient to drain the venous channels and is done when necessary. This appears to be more easily done than the bandaging technique of Pearce. It also leaves the legs free for secondary ligation.

The operative technique is modified from that of Pratt. Local anesthesia with 1 per cent procaine hydrochloride is used. A point 1 inch (2.5 cm.) below and 1 inch (2.5 cm.) lateral to the spine of the pubis is selected and an intradermal bleb is made (Fig. 6). This spot should be over the saphenous bulb and occupies the center of the incision. In obese people the inguinal fold may be considerably below this spot. It may even be necessary as Dunlop suggests to make the wound on top of the fatty apron. The line of incision, parallel to Poupert's ligament is infiltrated and the area anesthetized through the original bleb by advancing and retracting the needle point fanwise through the subcutaneous tissue. If the point of the needle is in continuous motion it is not necessary to test for vascular penetration by

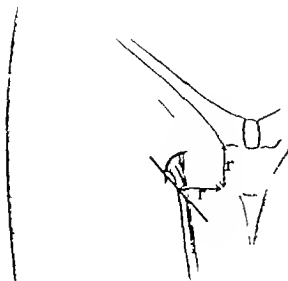


Fig. 6. Location of incision.

withdrawing the syringe. About 40 cubic centimeters of the anesthetic are generally used.

An incision 2 to 3 inches (5.0 to 7.5 cm.) long is made, depending on the thickness of the fatty layer. The operation is more quickly and safely done through an adequate incision. The vein is

safely exposed by sharp dissection as traction is applied to the wound edges. Two layers of substantial superficial fascia are met and divided. In thin persons the deeper layer lies close to the vein. In the obese there is often considerable fat under this fascia through which the vein runs. Retraction is by means of spring self-retaining retractors. The vein is usually met at about the level of its lowermost tributary. It is dissected free from its bed. Exposure of the saphenous bulb is then completed by separating adventitia and fascia from the vein and dividing upward. This makes necessary a minimum of retraction (Fig. 7). In the majority of cases the superficial external pudendal artery crosses over the bulb. It serves as a landmark and may be divided if necessary. Often the artery passes next beneath the saphenous vein and occasionally it divides, sending small branches both over and under the vein.

The saphenous is freed up to its confluence with the femoral and all tributaries are divided between ligatures of No. 0 chromic catgut. From three to five are usually encountered. The saphenous is then ligated as high as possible with chromic No. 0 catgut. It is clamped distal to the and again 1 inch (2.5 cm.) lower. The intervening vein is removed. The proximal stump is secured with a C silk transfusion ligature distal to the first tie.

The distal stump is grasped laterally with clamps (Fig. 8) and the occluding clamp is re-

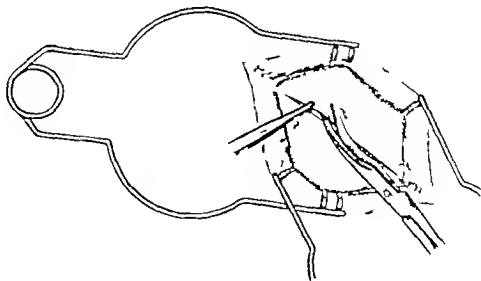


Fig. 7. Fascia lifted upward along course of vein to facilitate exposure of saphenous bulb and ligation of tributaries.

moved. A ligature of chromic No 0 catgut is readied with a half knot and a No 6 French ureteral catheter is introduced into the vein. It will usually enter 25 to 50 centimeters without difficulty. Occasionally the tip catches in a valve leaflet or tributary opening. Partial withdrawal and axial rotation of the catheter will usually enable it to slide past these obstacles but one must be careful not to push too hard as the vein wall is easily penetrated.

This procedure must be done quickly as the vein goes into spasm almost immediately. If the catheter becomes blocked and must be withdrawn reinsertion is almost impossible. When the catheter is at maximum insertion the half knot is tightened to prevent regurgitation and wet saline sponges are packed about the vein opening to prevent any back flow into the tissues. From 30 to 100 cubic centimeters of 3½ per cent sodium picnolate solution are injected depending on the size of the varices and the depth of insertion of the catheter. Twenty five per cent of the sclerosing is first injected and the remainder is distributed uniformly along the course of the vein as the catheter is withdrawn. Occasionally one is unable to penetrate further than 20 centimeters or so even in the presence of a large saphenous vein. This is usually due to excessive tortuosity. The sclerosing solution can then be distributed distally by means of a gentle sweeping massage while it is being injected. A larger amount can be introduced with safety and more complete sclerosis obtained. The knot is completed and reinforced with a C silk transfixion applied above the catheter. (If the vein is penetrated below this the

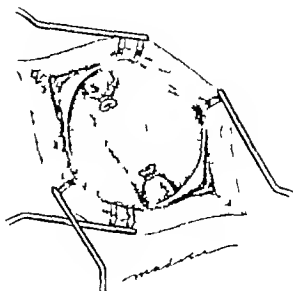


Fig 9. Operative site ready for closure. Thoroughly irrigated with saline.

sclerosing solution will leak.) The wound is irrigated with saline (Fig 9). Several interrupted line catgut sutures are placed in the superficial fascia and the skin is united with interrupted silk vertical mattress sutures.

While the assistant closes the wound the surgeon attends to the blowouts. The previously marked lines of incision 1 to 2 inches long are heavily infiltrated with 1 per cent procaine. This infiltration serves to separate superficial veins from the skin to which they closely adhere following phlebitis or chronic dermatitis and edema of long standing. The skin is cleanly incised and retracted with small rakes. Allis clamps necrotize the skin and should never be used to grasp skin edges. The vein is grasped, freed and all available tributaries are clamped and divided. The T shaped junction between vessel and perforator is sought. The vein is divided above and below between clamps to prevent escape of the sclerosing solution. Should any escape the wound must be immediately flushed with saline. The vessels are tied with No 00 plain catgut. Chromic catgut was found to be poorly absorbed by this thickened poorly vascularized tissue particularly in the lower leg. The wound is closed loosely with two or three vertical mattress silk sutures.

Ligation of the lesser saphenous is accomplished in a similar fashion (Fig 10).

Dressing must be carefully done. The femoral incision is entirely sealed with adhesive especially in women. The lower gauze dressings are held in place with diagonal rather than circumferential

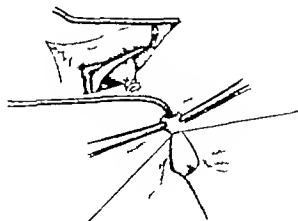


Fig 8. Technique of retrograde sclerosis. Half knot; retracts reflux.



Fig. 1. Varicosities of lesser saphenous system. a, Posterior view. Large venous channel marked where it lies beneath fascia. X marks site of ligation. b, Oblique view. Note enlarged greater saphenous coursing down medial aspect of knee. An excellent result was obtained in this case by ligating and sclerosing both greater and lesser saphenous veins.

strips of adhesive to obviate tension in the event of swelling. If retrograde sclerosis has been done the femoral and leg regions, groin to ankle, are padded with combination dressings and the entire extremity bandaged firmly with two 4 inch Ace type bandages. If sclerosis has not been done, it is unnecessary to pad the leg but a 4 inch Ace type bandage is applied from toes to knee.

Postoperative care. Immediately the operative dressing is finished the patient is made to walk for 5 to 10 minutes. This distributes the sclerosing solution more evenly enhancing its effect. 'Puddling' is prevented and danger from vein break down and its attendant difficulties is minimized. Following this, the patient goes to bed. Thereafter he is required to walk 10 to 15 minutes every 2 hours until he becomes completely ambulatory. The outer bandages are removed after 6 hours and additional padding is placed over any point which seems unduly irritated. The padding is discarded

after 3 to 5 days. The Ace bandages are replaced daily. Most patients go home wearing Ace bandages to the knee only. If the varices above the knee are large, it may be necessary to bind the thigh for 2 to 3 weeks. When retrograde sclerosis is done the average hospital stay is 4 days if one, and 6 days if both sides are operated upon. If simple ligation has been done, the patient usually goes home the following day.

The Ace bandages (or well fitting stockings) are worn for from 8 to 12 weeks or until sclerosis is complete, being removed only to bathe or when the patient is in bed. When sclerosis is complete the Ace bandages are discarded *gradually*. The legs will swell if this is not done as vascular tone takes time to return. I have the patient put on the Ace bandages as usual in the morning and wear them until late afternoon, when they are removed. If no swelling appears by bed time, the bandages are removed the next day in midafternoon. Thus the hour of removal gradually becomes earlier until the patient goes without bandages entirely.

Postoperative injections. Where simple ligation has been done injections are begun as soon as the wounds are well healed, i.e. 10 to 14 days. Multiple (three or four) punctures at one visit can be made as tolerated. I do not inject more than 1.5 cubic centimeters in one place or more than 50 cubic centimeters at any one time.

If retrograde sclerosis has been done one should wait at least a month before injecting any remaining veins. Frequently no further injections are necessary. It is my experience that many vein segments not initially thrombosed will become so without injection during the first 4 weeks after operation. The average patient, however needs 3 to 6 injections to complete the obliteration of the varices. I prefer to give an extra injection or two later than inject too much sclerosing agent at the time of operation. Pratt originally used 20 to 40 cubic centimeters of solution. I use about one quarter of this quantity.

Complications

1 Postoperative reactions. A febrile response to retrograde sclerosis occurs depending on (a) the amount injected, (b) the size of the varices, and (c) whether both legs are done. On the second and third days the temperature may reach 100.5 to 101.0 degrees F. Occasionally it is higher. This need occasion no alarm because better and more complete sclerosis occurs after increased febrile response. However reaction higher than 103 degrees F is considered abnormal. Although I have noted no permanent ill effects, these patients

should be watched closely. I have seen several instances in which the temperature reached 105 degrees F on the third postoperative day and one instance in which it reached 107.4 degrees F. All these complications were either in postphlebitic patients or in patients who showed signs of heightened vascular irritability. These patients were kept in bed with the legs elevated. Papaverine $\frac{1}{2}$ to 2 grains was given every 4 hours to lessen vascular spasm. Paravertebral novocain fluid was used in the more severe cases and extra fluids were administered. Possibly these reactions could have been avoided with proper selection of cases for sclerosis.

2 *Femoral thrombosis*. I have observed no case of femoral thrombosis—a fact attributable to the exclusive use of local anesthesia which makes the patient immediately ambulatory.

3 *Hemorrhage*. No serious bleeding has been encountered following the use of silk transfexion of the saphenous stump. Occasionally the femoral bandage becomes blood soaked during the period immediately after operation. This seepage of blood can always be controlled by pressure.

4 *Infection*. Avoidance of infection depends, I believe on (a) the use of a single puncture wound for anesthesia, (b) delay of operation until dermatitis and other infections are cleared up, (c) avoidance of injury to enlarged femoral lymph nodes during operation, (d) prevention of contamination by proper dressing and the covering of the wound surface with sulfanilamide powder.

5 *Delayed healing of wounds*. Delayed healing of wounds frequently occurs without infection and only in the lower leg wounds. The lower the incision the more liable is healing to be slow. Healing is frequently delayed about the ankle when incision has been made through edematous, chronically inflamed skin. This difficulty is met with elevation, warm soaks, and suitable dressings.

Follow-up

The patients are seen at intervals after sclerosis is completed. The legs are inspected at the time the Ace bandages are discarded and again 3 months later. After this I see them at intervals of 6 months. Any visible additional varices can then be injected. New varices occur and are not to be mistaken for recurrences. Occasionally recanalization of certain channels occurs. This has been due usually to the presence of a blowout missed at the initial examination. Simple excision of the blowout followed by an injection or two remedies the situation.

SUMMARY

The origin of varicose veins is discussed and their anatomical types are enumerated together with the several types of bodily configuration in which varicose veins are most liable to occur. Different methods of treatment and their indications are outlined. Injection of veins and operative technique are discussed in detail. Contra-indications to the use of sclerosing solutions include (1) saphenous thrombophlebitis, (2) vasospastic disease of the lower extremities, (3) obliterative peripheral vascular disease, (4) abnormal reactivity to the test dose. Postoperative complications, their avoidance and treatment are described. Analysis of cases and late results will be the subject of further communication when more time has elapsed.

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ADENOCARCINOMA CYLINDROMA TYPE OF THE PAROTID GLAND

A Clinical and Pathologic Study of Twenty One Cases

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IN a previous study by two of us (Dockerty and Mayo 4) it was pointed out that there occasionally arose in the submaxillary salivary gland a type of neoplasm variously known as cylindroma¹ adenocarcinoma cylindroma type or basal cell carcinoma with hyaline stroma. The incidence of this tumor in a large series of submaxillary glandular neoplasms, was approximately 20 per cent. Throughout the literature as well as in our own series this tumor had been confused with the ordinary type of mixed salivary glandular neoplasms. In this group of cylindromas recurrence was extremely high and metastasis frequent with more than 50 per cent of patients succumbing from the effects of widespread dissemination of the disease. Clinically cylindromas could not be distinguished from the group of mixed tumors although pain was a contrastingly frequent symptom. Surgically the infiltrative tendencies observed by the surgeon made him sometimes question a fresh tissue diagnosis of cellular mixed tumor. However in this previous communication distinctive microscopic features of cylindroma were presented and it was shown that the surgical pathologist familiar with the cellular pattern could render a real service in advising radical operative procedures when such a neoplasm was encountered.

More recent experiences (5) demonstrated that adenocarcinomas of the cylindroma type affecting the tongue and the parotid gland were also dangerous from the standpoint of metastasis. Mulligan, in a recent review reported instances of 12 metastasizing mixed tumors, many of which had been primary in the parotid gland. Interestingly enough most of the illustrations in his article duplicated the microscopic appearance of

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The term "cylindroma" never used in this paper appears as an abbreviation for "adenocarcinoma of the type cylindroma."

cylindroma in all major features. Since investigators still confuse mixed tumors with cylindromas and Bauer and Fox, on the basis of 3 tumors, stated that cylindromas are generally benign, it was thought advisable to consider a group of primary neoplasms of the parotid to ascertain whether or not cylindromas occurred there and, if so, whether or not their clinical behavior was that of their submaxillary counterpart.

MATERIALS AND METHODS

Material was available on 210 consecutive cases in which primary parotid neoplasms had been removed surgically at the Mayo Clinic between the years 1928 and 1936 inclusive. This particular group of specimens was selected because it represented a series large enough to warrant conclusions as to the probable general incidence of parotid cylindromas and because it allowed ample time for a follow up in the cases occurring in the later years of the series.

Before any records were reviewed these 210 formalin-preserved tumors were carefully studied in gross detail special attention being paid to the features of size, color, consistency, presence or absence of encapsulation, amount of parotid glandular tissue removed, presence of attached lymph nodes and so forth. Multiple blocks were cut from the tumors, the adjacent salivary gland, and regional lymph nodes when available. These blocks were placed in a 10 per cent solution of fresh formalin sectioned at a thickness of approximately 10 microns and stained routinely with hematoxylin and eosin. Study of these sections brought to light 21 tumors which, although in many instances previously labeled atypical mixed tumors, seemed to fulfill the criteria for a revised diagnosis of adenocarcinoma of the cylindroma type. The present report deals with the clinical and pathologic details of this group of 21 cases.

PATHOLOGIC DATA

Gross features. In 19 cases the material was such as to suggest that total or subtotal removal of the tumor had been performed and in 2 instances



Fig. 1 Grade 2 adenocarcinoma, cylindroma type illustrating resemblance to basal cell carcinoma. The honeycombed plaques of malignant cells are distinctive, as is also the hyaline stroma. The so-called capsule shown in the upper portion of the photomicrograph is extensively invaded by malignant cells (hematoxylin and eosin $\times 44$).



Fig. 2 Grade 2 adenocarcinoma, cylindroma type illustrating again the basic architecture in addition to the phenomenon of perineural invasion by carcinoma cells (hematoxylin and eosin $\times 44$).

only a small biopsy specimen was available for study. All of the tumors were unilateral. In 4 cases the entire parotid gland was attached to large neoplasms of an infiltrative type and in 2 additional instances the presence of attached malignant appearing cervical nodes indicated that fairly extensive operations had been performed. In 7 of the remaining 17 cases the tumor appeared in the form of single or multiple grayish white encapsulated nodules. Rarely could the capsule be separated with ease from the underlying tumor tissue. Nonencapsulated examples always demonstrated invasion of attached parotid glandular tissue or the surrounding adipose connective tissue and portions of striated muscle which were occasionally removed with the operative specimen. In 1 case an attached portion of the mandibular ramus was grossly invaded by neoplastic tissue.

Microscopic features. The microscopic appearance of these tumors differed in no essential respect from that detailed in a previous study (Figs. 1 to 6). The general architecture was that of islands and strands of small dark-staining cells with hyperchromatic nuclei. Many of the units demonstrated central honeycombing with clear

spaces which in some instances were filled with hyaline substance, in others were occupied by globules of material which stained positively for mucus and in still others were empty. The stroma was in general hyaline. Infiltrative tendencies were pronounced the tumor capsule, the attached parotid glandular substances, the surrounding fat and so forth frequently demonstrating invading strands of tumor tissue running out from the parent growth. Perineural involvement was observed in all 11 instances in which nerve fibers were found. Metaplasia to epithelium of a squamous type was noted in 2 tumors. All the other neoplasms were pure adenocarcinomas of the type cylindroma, 14 being of grade 2 and 7 of grade 1 malignancy according to the method of Broders. In 2 instances portions of the neoplasm demonstrated appearances somewhat typical of mixed tumor. Previous experience had taught us that this group of 'intermediates' ran the clinical course of cylindromas and accordingly they were included in the present series.

CLINICAL DATA

Incidence. The incidence of parotid adenocarcinomas of the cylindroma type was 10 per cent of the entire group. Stein and Geschickter observed



Fig. 3. Grade 3 adenocarcinoma, cylindroma type, illustrating marked cellularity, poor glandular formation and infiltration with splitting of the capsule. Excision in this case would have left behind multiple tumor seedlings (hematoxylin and eosin $\times 10$).



Fig. 4. Grade 1 adenocarcinoma, cylindroma type, is a picture of good acinar formation and other evidence of cellular differentiation. The infiltrative propensity is evidenced with the invasion of fat (hematoxylin and eosin $\times 44$).

a 15 per cent incidence of this type. The corresponding figure for the submaxillary salivary gland was 18.5 per cent according to Dockerty and Mayo (4).

Sex. Men and women were almost equally represented in this series, in keeping with the observation in the literature that salivary glandular neoplasms have no particular sex predilection.

Age. The average age of the patients was 49.8 years with extremes of 32 years and 65 years.

Symptoms. The commonest symptom related by the patients was the presence of a tumor with an incidence of 100 per cent. The duration of the swelling varied from 6 months to 15 years with an average of about 7 years. It was thus impossible to judge, on the basis of this symptom alone, the nature of the underlying pathologic process.

Half of the patients additionally complained of pain which was constant and localized in 2 instances and intermittent and lancinating in the remainder. Six patients had experienced extension of pain across the face, over the forehead or down into the neck, the character and distribution indicating irritation or actual invasion of a nerve by the tumor. In our experience pain was an unusual feature in connection with mixed salivary

glandular neoplasms and its presence in patients suffering from primary parotid and submaxillary swellings should make one alert to a possible underlying adenocarcinoma of the cylindroma type.

On physical examination 10 tumors involved the right and 11 the left parotid gland. All tumors were unilateral. Location was generally described as being preauricular with certain tumors varying in occupying a high or a low position. The average estimated size was 4.5 centimeters with variations from 1 to 7 centimeters. Whereas 10 of the tumors were somewhat movable, resembling mixed tumor in this regard, the remainder were described as being fixed a feature suggesting the presence of infiltration. As pointed out previously, local fixation of the tumor is an important sign in distinguishing adenocarcinoma of the cylindroma type from mixed tumors of the salivary glands. Partial or complete paralysis of the facial nerve was present in 25 per cent of the cases at the time of first examination at the clinic. Whereas in several instances it is possible that this paralysis follows the performance of a previous operation we feel on the basis of pathologic studies that it is most often brought about through perineural invasion of the seventh nerve.

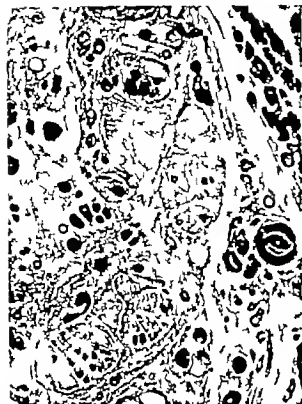


Fig 5. Grade 2 adenocarcinoma, cylindroma type. This neoplasm was "recurrent" and illustrates extensive invasion of striated muscle (hematoxylin and eosin $\times 44$).



Fig 6. Grade 2 adenocarcinoma, of the cylindroma type, with the invasion of a lymph node (hematoxylin and eosin $\times 44$).

At operation only 39 per cent of the tumors were invested by anything which could be described as being a capsule, the remainder demonstrating evidence of infiltration. It was estimated that complete excision was accomplished in 50 per cent of the cases. However, several of the cases in which the surgeon made a note regarding residual tumor tissue were instances in which previous operation had been performed and the neoplasm was listed as a recurrence.

TREATMENT AND RESULTS

Treatment consisting of wide local excision alone or combined with postoperative therapy using roentgen rays was employed in 15 cases. Complete parotidectomy was performed 4 times for large neoplasms, 1 of which represented a recurrence following a previous "local" operative procedure. In the 2 remaining instances biopsy followed by roentgen therapy was the therapeutic regimen dictated by the presence of an irremovable tumor mass. Fourteen of the patients received their first treatment at the Mayo Clinic. In 7 cases treatment instituted elsewhere was continued at the clinic because of neoplasms which had recurred.

Follow-up studies are available on 20 of these 21 patients and the detailed results are given in

Table I. Although we have no necropsy data on the 10 patients who have died, presumption that death was owing to the effects of carcinoma is afforded by roentgenograms positive for pulmonary metastasis in 5 of the group and of cervical nodal metastasis in 2 additional cases. The 5 patients who are living without any evidence of recurrence represent a disappointingly small group (25 per cent). The 2 deaths and the 2 recurrences in the group subjected to total parotidectomy make a poor showing for an operation of such magnitude. However, these 4 patients were suffering from very large infiltrating neoplasms. Paralysis of the facial nerve was present in 25 per cent of the patients on their first admission. It developed in an additional 43 per cent at a time following operation, which indicated a causation based on infiltration by recurrent tumor in all except the 3 cases in which the nerve was purposely sacrificed in the operative attempt to eradicate large tumors.

COMMENT

Although adenocarcinoma of the cylindroma type occurs in all locations which provide the tissue of origin for mixed tumors of the salivary glandular type, it is our firm opinion that there is no justification for including the two types within the same category. Histogenetically mixed tu-

TABLE I.—RESULTS OF TREATMENT IN CASES OF ADENOCARCINOMA CYLINDROMA TYPE OF THE PAROTID GLAND

Case	Treatment	Final results	Cases	Percent
	Palliative x-ray	Dead in 5 years		
	Palliative rx and radium	Dead in 5 years		
3	Local excision	Dead in 5 years		
	Local excision and radium	Dead in 5 years		
5	Local excision and x-ray	Dead in 5 years		
6	Careful excision and radium	Dead in 5 years		
7	Parotidectomy and x-ray	Dead in 5 years		
8	Parotidectomy x-ray and radium	Dead in 5 years		
Total cases (dead in 5 years)			8	40
	Local excision and x-ray	Dead in 3 years		
	Local excision and x-ray	Dead in 4 1/2 years		
Total cases (dead after 5 years)				
	Local excision and radium	Living 6 years recurrences		
	Parotidectomy and x-ray	Living 7 years 6 recurrences		
1	Local excision and radium	Living 7 years Last recurrence years ago		
14	Parotidectomy and x-ray	Living 6 years recurrences		
Total cases (living with repeated recurrences)				20
5	Local excision	Living 11 years (Status melanoma)		1
16	Local excision	Living 7 years No recurrences		
7	Local excision and radium	Living 7 years No recurrences		
8	Local excision and radium	Living 6 years No recurrences		
	Local excision, radium and x-ray	Living 20 years No recurrences		
20	Local excision, radium and x-ray	Living 14 years No recurrences		
Total cases (1 blood recurrences)			5	5

more arise from the epithelial cells of the salivary and lacrimal glands and also from mucous glandular elements of the lip, tongue, palate, larynx, and trachea. The tumors are well differentiated, often reproducing in fair detail the double layering of epithelium which characterizes the appearance of a normal salivary duct. A cartilage-like stroma is typically encountered. In adenocarcinoma of the cylindroma type ducts lined by double layers of epithelial cells are lacking the appearance being that of dark-staining honey-combed epithelial plugs. This may indicate as

suggested by Bauer and Fox, a derivation from the basal basket, regenerative or "invo-epithelial" layers of the glands and ducts of origin. Cartilaginous stromal changes are not observed but hyallinization of the stroma is of frequent occurrence.

Clinically location and duration are features which in a given case are by no means diagnostic of cylindromas as opposed to mixed tumor. The clinical incidence of pain, however, was 50 per cent in our group of cylindromas. In our series of submaxillary neoplasms pain had an incidence of 70 per cent as opposed to a 50 per cent incidence as a symptom of mixed tumor. Accordingly we feel that pain, especially of a sharp radiating nature is of importance in differential clinical diagnosis. Of parallel significance was the finding of fixation which in our experience was a noteworthy feature of cylindromas.

At surgical exploration cylindromas were found to be infiltrative in more than half of the cases and rarely in these cases was the surgeon satisfied that he had completely eradicated the disease. That his estimate was correct is attested by a recurrence rate of 75 per cent about three times the incidence for recurrence of mixed tumors (3). The question is therefore raised whether or not more radical surgical measures should not be undertaken for this more malignant cylindroma group. To most surgeons the mere mention of parotidectomy calls up at once the specter of a patient with severe facial palsy. However the analysis of this series reveals that almost one third of the patients had partial or complete paralysis of the homolateral facial nerve at the time of admission and this incidence reached two-thirds at the final analysis. That this figure is three or four times as great as the corresponding one encountered among patients operated on for mixed tumor (3) lends strong support to our pathologic observation that perineural involvement by tumor tissue rather than surgical trauma had been the factor responsible for the paralysis.

Admittedly if paralysis, complete or incomplete, of the facial nerve exists preoperatively it is due to the perineural invasion or pressure of the tumor.

If paralysis develops immediately after operation it is due to surgical interference with the nerve. This paralysis may be partial or complete. If it is partial it is usually due to tension or stretching of the nerve and slowly improves. If it is complete immediately the paralysis of the nerve is likely to be surgical and permanent. In a small percentage of cases, however complete paralysis may become partial and in a much smaller

number the patient may completely recover from it.

Paralysis developing a month or more after surgical resection can be safely attributed to incomplete eradication of the pathologic process and continued extension by infiltrating involvement.

Bailey has performed total parotidectomy for 7 parotid tumors with resultant palsy of the seventh nerve in 1 instance only demonstrating thereby that surgical interference with the nerve can at least occasionally be avoided.¹ In the 4 cases in which total parotidectomy was done in the present series the facial nerve had to be sacrificed because of large infiltrating neoplasms. Subsequent recurrence in all 4 cases and death in 2 of them indicated to us merely that the operation was too late rather than too little. It seems logical to assume that since resection of the gland although usually effective in the treatment of mixed tumors is followed in the cylindroma group by a 75 per cent incidence of recurrence, procedures at least approaching total parotidectomy should here be given a fair trial. We further feel that block dissection of cervical nodes on the involved side should be seriously considered. In this regard as mentioned in the foregoing the surgical pathologist familiar with the appearance of these tumors in fresh frozen sections can render a real service to his surgical colleagues.

While therapy with roentgen rays did not in the present series have any pronounced effect in the prevention or control of recurrences we feel that its possible benefits should never be denied to any patient suffering from this serious form of cancer.

SUMMARY AND CONCLUSIONS

1 Ten per cent of a series of consecutive primary parotid neoplasms appeared to be adeno-

M. Whorter showed that the human parotid gland consists of larger superficial and smaller deep lobe usually distinct and readily separable. The facial nerve and its branches lie between these lobes and not, as this the actual glandular substance. The two lobes are joined by an isthmus which separates the temporofacial and cervicofacial divisions of the main nerve trunk.

carcinomas of the type cylindroma so classified because of a distinctive microscopic pattern.

2 This group of 21 cases was characterized clinically by the presence of sharp radiating pain and local fixation of tumor in 40 per cent features unusual in connection with other primary neoplasms of this location. Partial or complete paralysis of the facial nerve was also a contrastingly common finding.

3 Surgically the tumors were generally more infiltrative than encapsulated and application of the principle of 'wide local excision' prevented recurrences in 5 of 21 cases.

4 Pathologically the appearance of dark staining epithelial islands and strands with central honeycombing in a hyaline stroma was diagnostic. Epithelial mucus was sometimes present. Infiltrative tendencies were pronounced with a special predilection for invasion of nerve sheaths.

5 Eight of the 20 traced patients succumbed within 5 years to the effects of metastasis, 5 with evidence of pulmonary spread. Two died more than 5 years after operation. Four of the remaining 10 are suffering from inoperable (?) recurrences.

6 Solid tumors of the parotid gland should be assumed to be malignant until proved otherwise.

7 It is suggested that more radical surgical procedures will have to be done in order to obtain better results in the treatment of this form of neoplasm.

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A CLINICAL STUDY OF EARLY POSTOPERATIVE AMBULATION IN GYNECOLOGY

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WITH surgical efficiency at its present level, we should not be satisfied merely with recovery from a surgical operation but we should know as Matas once stated how the patient has recovered, to what extent she has been restored to her anatomical and functional integrity to what extent she has been cured and made fit to return to her normal life and occupation how long it has taken her fully to recover after the operation and what are the end-results.

There is no excuse for leaving a single stone unturned to mitigate the suffering shorten the convalescence, and eliminate the economic waste incident to surgery on human beings (20) and, if early postoperative ambulation is an added means toward this end, then its use should be more widely adopted.

A comparison of the relative merits of early ambulation with those of late ambulation will be made in the following report. This presentation may in effect, along with similar preceding reports (17 22 23 25 27) remove prejudice and add to the surgeon's postoperative therapeutic armamentarium. Of course, there are limitations and although this series was consecutively treated by early ambulation, the surgeon's judgment should individualize each case. However the results demonstrate that fear of early ambulation is in the majority of cases, unwarranted.

PRESENTATION OF DATA

Fifty four consecutive cases are herewith discussed. The first 17 patients were maintained on the conservative regimen of late ambulation the following 37 patients received early postoperative ambulation. No attempt was made to collect additional cases of patients treated by the old regimen because it was desired to maintain the factor of the operator constant. Because of this fact no attempt will be made to quote percentages only a relative comparison will be made.

Since the original compilation of this report, several additional patients were also treated by early postoperative ambulation with apparently

similar results, but are not herewith included because of insufficient follow-up.

All patients were charity cases, from many sections of the State of Nebraska. All patients received adequate preoperative care. Patients with low blood counts and hemoglobin values received adequate transfusions.

The technique of operation was constant in both series.

Of the patients ambulated early 7 had Pfannenstiel incisions, the remainder had midline incisions. All of the patients ambulated late had midline incisions.

In all total abdominal hysterectomies, 5 grams of sulfathiazole powder or crystals was introduced into the abdomen prophylactically. In other cases, only in the presence of old infection was sulfathiazole powder or crystals used.

Abdominal closure was made by layers, the peritoneum was closed by a continuous stitch of No. 0 or No. 1 plain catgut the fascia was closed by a continuous stitch of No. 0 or No. 1 chromic catgut from each angle to the middle of the incision the skin was closed with fine dermal interrupted vertical mattress sutures. No tension sutures were used (except in the case of 1 patient because of obesity—weight 225 pounds—on whom an incidental incisional ventral herniorrhaphy was performed).

Spinal anesthesia was used in the majority of cases cyclopropane and ether were used when spinal anesthesia was refused. In a very few cases, the spinal anesthesia was supplemented with cyclopropane and ether near the close of the operation. One elderly patient aged 74 years, was operated upon under local anesthesia of 1 per cent novocain for the removal of a very large ovarian cyst a multilocular serous cystadenoma.

There were no postoperative dietary restrictions in either series. Diet was taken as tolerated liquids, soft or regular. Intravenous fluids were rarely administered immediately postoperatively and this treatment was carried out only if the operation was extensive. Fluids were usually taken orally.

A retention catheter attached to a bottle was used after all plastic operations and vaginal hysterectomies. In the patients ambulated early

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TABLE I.—EARLY AMBULATION

Type of operation	Pathology	No. cases
Total hysterectomy 3 cases	Fibromyomatous uteri Highly malignant sarcoma 1 case Adenocarcinoma of cervix Uterine bleeding, cause unknown	
*Subtotal hysterectomy 6 cases	Fibromyomatous uteri Chronic pelvic inflammatory disease	4
Laparotomy 3 cases (Incidental appendectomy as done in 8 cases)	Simple cystic ovaries Bilateral polycystic ovaries Multilocular serous cystadenoma of ovaries Right tubo-ovarian abscess and periappendicitis Retroverted uterus Scarred appendix and appendix vesicle	4
Vaginal hysterectomy and colpoperineoplasty 3 cases	Fibromyomatous uteri with cystocele Prolapsed uteri (2-3") with cystocele (1 patient had fibromyomatous uteri)	3
Plastic operation 7 cases (includes urethroplasty and Manchester opera- tions)	Marked cystocele Marked cystocele (fol- lowing total hysterectomy) Urethrocele and rectocele Prolapsed (?) of uterus with elongated cervix with cervical-cystocele	4
Combined abdominal and plastic operation cases	Marked cystocele with degrees prolapse and retroverted uterus Lacerated pelvic floor with chronic cervicitis and retroverted uterus	
Low cervical cesarean section case	Laceration, previous cesarean sections	

*Unilateral or bilateral salpingo-oophorectomy or incidental appendectomy were performed on some of these patients.

the catheter was kept in for the first 24 hours (except for 2 cases, one a vaginal hysterectomy performed on an obese patient weighing 217 pounds and the other a urethroplasty in which the catheter was kept in for 48 hours). In the patients ambulated late the retention catheter was used for 72 to 96 hours. In 3 total abdominal hysterectomies (2 in the early ambulated series and 1 in the late ambulated series) because some difficulty was encountered in the dissection of the bladder from the cervix a retention catheter attached to a bottle was used for the first 24 hours. In all other cases patients were catheterized only when necessary.

A study of the patients treated revealed the following salient features:

The age range of the patients treated by early ambulation was from 15 to 74 years of those treated by late ambulation 30 to 70 years. The mean age of those ambulated early was 41.2 years of those ambulated late 52.1 years. The weight range of the patients ambulated early was 110 to 225 pounds of the patients ambulated late

TABLE II.—LATE AMBULATION

Type of operation	Pathology	No. cases
*Total hysterectomy 3 cases	Fibromyomatous uteri Adenocarcinoma of uterus Uterine bleeding, cause unknown	
*Subtotal hysterectomy 4 cases	Chronic pelvic inflammatory disease Uterine bleeding, cause unknown Endometriosis of ovary with uterine bleeding, cause unknown Adenocarcinoma of ovaries with adenomyosis of uteri	
Laparotomy case	Bilateral prostatic	
Vaginal hysterectomy and colpoperineoplasty 4 cases	Prolapsed uteri 2-3 degrees with cystocele (one case of adenomyosis uteri) Complete procidentia uteri with marked cysto- rectocele	3
Plastic operation 3 cases (includes urethroplasty)	Marked cystocele (1 patient with elongated cervix, 1 with cervicitis requiring amputation) Urethrocele and rectocele	4

*Unilateral or bilateral salpingo-oophorectomy or incidental appendectomy were performed on some of these patients.

112 to 230 pounds. The nutritional status of the patients in both series was approximately the same.

In the early ambulation series, there were 2 patients with hypertensive heart disease, 1 with rheumatic heart disease, 2 with positive serology (Mazani) and 1 with chronic bronchitis. In the late ambulation series there were 3 patients with hypertensive heart disease and 2 with diabetes mellitus.

Wound healing was not affected by the positive serology or the diabetes mellitus in either series.

The surgery performed on the patients ambulated early included 5 total abdominal hysterectomies, 6 subtotal hysterectomies, 13 laparotomies for surgery other than hysterectomy, 3 vaginal hysterectomies, 7 plastic operations, 2 combined abdominal and plastic operations, 1 cesarean section (this case is included because of the abdominal surgery entailed). For the pathology associated with these cases see Table I.

The surgery performed on the patients ambulated late included 3 total abdominal hysterectomies, 4 subtotal hysterectomies, 1 laparotomy for surgery other than hysterectomy, 4 vaginal hysterectomies, 5 plastic operations. For the pathology associated with these cases see Table II.

The patients who were ambulated early wore tight abdominal binders and, in the majority of instances, got up in a chair on the first postopera-

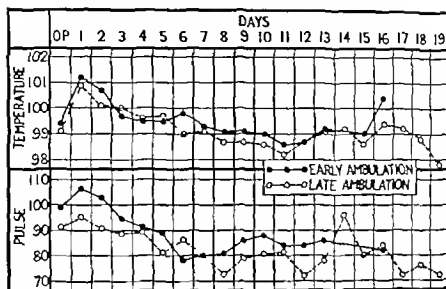


Fig. 1. A composite graph of the temperatures and pulse rates of both series.

tive day with bathroom privileges. A few because of hesitation and fear dangled on the first day (8 out of 37 patients). All patients were up and about on the second day. Two patients who had undergone vaginal hysterectomies and 1 who had undergone a urethroplasty were ambulated on the second day because a retention catheter was used for the first 48 hours. Early ambulation was not insisted on but was encouraged. This series includes 4 patients, 3 of whom ambulated themselves on the third day, 2 of whom ambulated themselves on the fourth day. The majority of patients who were ambulated late got up in a chair on the seventh or eighth day, 1 patient got up on the sixth day, 1 on the tenth day and 1 on the twelfth day.

A composite graph of the temperatures and pulse rates of both series (Fig. 1) such as was presented by Powers in his report, shows relatively little significant changes due to early ambulation. Like that of Powers, these were plotted by averaging the highest levels recorded for every patient on each day and thus represent maximal elevations during the convalescent period.

Postoperative invalidism, both psychical and physical, was markedly reduced in the patients who were ambulated early. There was less apprehension on the part of the patient and the family as to the patient's condition and prognosis. There was a notable decrease of the usual postoperative complaints on the part of the patient. Nursing care requirements were markedly reduced.

The necessity for catheterization of patients with abdominal surgery occurred for the most

part on the operative day and the number of patients requiring catheterization was relatively the same in both series. Of the patients ambulated early 7 of the 35 abdominal cases required catheterization and this on the operative day. One patient only required a second catheterization on the first postoperative day. Of those ambulated late, 3 of the 8 abdominal patients required catheterization and this was necessary on the operative day only.

All the patients on whom plastic operations and vaginal hysterectomies were done, whether ambulated early or late, showed the same relative frequency of catheterization following removal of the retention catheter. Of the patients ambulated early 2 out of 12 required catheterization once; of the patients ambulated late, 1 out of 9 required catheterization once. The early ambulated patients, however emptied their bladders more completely suggesting that in these types of operation there was an earlier return of bladder tonicity with early ambulation. Although a study of residual urine was not carried out in all cases due to a shortage of nurses, the findings in the cases in which this study was done seemed to confirm this fact. A more complete study of all the cases, made by averaging the lowest quantities of urine voided, the highest quantities voided and the frequency of voiding for the first 3 days following removal of the retention catheter revealed that the patients who were ambulated early voided larger quantities and less frequently (Table III).

In both series there were a few patients who were able to move their bowels without the aid of

hematoma however the incidence was greater among those who were ambulated early (14 of the 17 patients ambulated early compared with 2 of 17 patients ambulated late). There were no cases of abdominal distention in the patients who were ambulated early and only 1 case of moderate distention in the patients who were ambulated late.

The requirements of sedation during the operation were comparatively the same in both series. After early ambulation sedation was rarely required.

The number of hospital days here reported is not necessarily a true indication of the hospital days required for convalescence. Since patients came from many sections of the state and in many cases were required to travel great distances, discharge from the hospital was made according to the convenience of the patient and not necessarily at the time when the patient was physically able. Some patients stayed as long as 2 to 5 days beyond the time of discharge. Because this factor was constant in both series, the relative number of hospital days saved is still quite evident. The average number of hospital days required by the patients who were ambulated early was 8.72 days as compared with 13.94 days required by the patients who were ambulated late. Early ambulation therefore, saved an average of 5.22 hospital days per case. A comparison of the type of hospital days required according to the type of operation performed is given in Tables IV and V.

The patients ambulated early developed the following postoperative complications: unexplained fever 2 cases, acute bronchitis, 1 case, phlebitis, 1 case, hematoma in incision 1 case, phlebitis, 1 case, hematoma in incision 1 case.

Unexplained fever occurred during the postoperative course of 2 patients, one upon whom a hysterectomy had been performed and the other a plastic operation. Physical examination and laboratory findings were negative in both cases.

Acute bronchitis occurred in a patient weighing 217 pounds, with known chronic bronchitis, on whom a vaginal hysterectomy was performed. The patient had a predisposing focus of infection and it is possible to conceive that early ambulation in this very obese patient prevented the possibility of bronchopneumonia.

Phlebitis occurred in a patient on whom a urethroplasty was performed. Early ambulation in this patient was evidently insufficient prophylaxis against this attack of phlebitis. It may be noted that this patient had a milk leg in the opposite leg 20 years ago following a normal delivery.

TABLE III

Patients	Lowest quantity voided Ounces	Highest quantity voided Ounces	Frequency per day
Ambulated early	5 (50 c.c.)	3 (500 c.c.)	4
Ambulated late	4 (50 c.c.)	(500)	6

A hematoma in an incision occurred in a patient who had a Gilliam suspension. The hematoma was at the level where the round ligaments were anchored to the fascia and evidenced itself by a 1 inch gape of the incision on the sixth postoperative day. While this hematoma may be attributed to early ambulation it is conceivable that a small unrecognized bleeder may have been produced at the time of operation in one of the perforations of the fascia and recti muscles through which the round ligaments were drawn. The patients ambulated late developed only 1 postoperative complication: 1 case of unexplained fever. Unexplained fever occurred after operation in a patient who had undergone a vaginal hysterectomy. Physical examination and laboratory findings were negative.

The follow-up on these patients revealed that the convalescent period at home was much less for those patients who were ambulated early. Of the patients ambulated early 8 were able to resume their normal activities immediately after leaving the hospital of those who were ambulated late only 1 was able to do so. The average convalescent period at home required by the patients who were ambulated early was 3.87 weeks, compared with 6.5 weeks required by those who were ambulated late. The average total convalescent period required by those who were ambulated early was therefore 3.3 weeks less than that required by those ambulated late. The duration of convalescence according to type of operation is shown in Tables IV and V.

A follow up of both series, over a period of 6 to 8 months, has revealed no disruption of wounds, no incisional ventral hernias, no recurrent cystoectoceles, no prolapse of the vault of the vagina following vaginal hysterectomies.

DISCUSSION

The above data reveal certain obvious clinical advantages in early postoperative ambulation. A study of the etiology and pathology of postoperative pneumonia, atelectasis, embolism in the lungs, phlebotrombosis, etc., indicates that early ambulation also offers advantages in the prophylaxis of these conditions.

With the patient on her back following surgery the stage is set for many hours of recumbency with

TABLE IV—EARLY AMBULATION

Type of operation	Hospital days (Average) Days	Convalescent period home (Average) Days	Total convalescent period Days
*Total hysterectomy	9.2	29.4 (4 weeks)	38.6 (5.6 weeks)
**Subtotal hysterectomy	8.6	8 (1 weeks)	16.6 (2.4 weeks)
Laparotomies	7	20.0 (2.8 weeks)	27.0 (3.9 weeks)
Unilateral hysterectomy and colporrhaphy		21.2 (3.0 weeks)	28.2 (4.0 weeks)
***Plastic operations		25 (3.6 weeks)	32 (4.6 weeks)
Combined abdominal and plastic operations	9.5	22 (3.1 weeks)	31.5 (4.5 weeks)
Low cervical cesarean section	9	25 (3.6 weeks)	34 (4.9 weeks)
All types averaged in total	8.7	27.0 (3.9 weeks)	35.7 (5.1 weeks)

*Unilateral or bilateral salpingo-oophorectomy or incidental appendectomy were performed on some of these cases.

†Number of hospital days recorded are not necessarily the actual number of hospital days required—frequent home transportation difficulty.

**1 case complicated, requiring 3 days is not averaged.

shallow breathing (4, 25). There is a pooling of the tracheobronchial secretions in the finer ramifications of the bronchial tree and very often a disinclination to cough due to pain. This, in association with the limitation of the respiratory excursions, allows for an obstruction in the distal bronchioles. The free drainage by which the lung is kept in an aseptic condition is interfered with the air distal to the obstruction is absorbed the corresponding lobules collapse and in the occluded area, with a predisposing infection, a mild pneumonia may develop.

The increased lung expansion afforded by the exercise of early ambulation would no doubt aid in the prevention of the pooling and stasis of the tracheobronchial secretions, and hence early ambulation should be definite prophylaxis against such pulmonary complications.

The metabolism (7) and muscle tone of the recumbent patient are low. There is a decrease in the volume of flow in all the vessels of the body. The venous pressure is low and the caliber of the

veins, especially in the abdomen, pelvis, and legs, is much smaller than when sitting up. Only when the patient is sitting or standing are these veins constantly dilated. Frykholm suggested that collapsed veins may have endothelial damage, predisposing to later thrombosis. Veins, which are compressed and empty due to pressure of the legs against the bed as suggested by Dock, may easily suffer endothelial damage and begin to thrombose while nearly empty. Dock further pointed out that phlebotrombosis may begin in the venules of the muscles and subcutis, or in the pelvic venous plexuses where complete stasis is possible. The formation of large clots propagated far along the system is made possible by prolonged recumbency. The dislodgment of clots with the formation of emboli is effected when after this prolonged recumbency there is a sudden rise of venous pressure such as is produced by getting out of bed or straining on a bed pan.

Pulmonary embolism has always been a by-product of surgery especially in gynecology and

TABLE V—LATE AMBULATION

Type of operation	Hospital days (Average) Days	Convalescent period home (Average) Days	Total convalescent period Days
*Total hysterectomy	5	36 (5.1 weeks)	41 (5.9 weeks)
**Subtotal hysterectomy	3	00	00
Laparotomies		22 (3.1 weeks)	25 (3.6 weeks)
Unilateral hysterectomy and colporrhaphy	12.5	20.0 (2.8 weeks)	32.5 (4.6 weeks)
Plastic operations	8	26 (3.7 weeks)	34 (4.9 weeks)
All types averaged in total	7.94	23.5 (3.4 weeks)	31.4 (4.5 weeks)

Unilateral or bilateral salpingo-oophorectomy or incidental appendectomy were done in some of these cases.

†Number of hospital days recorded are not necessarily the actual number of hospital days required—frequent home transportation difficulty.

**Of cases—reported immediate resumption of usual activities; failed to report—were fully active at the end of 2 weeks and with delayed advancement of exercise with assistance, as well as arrived at 7 weeks. Therefore the average convalescence could not give true average for the period of convalescence for that type of surgery.

obstetrics. It may occur suddenly in uncomplicated cases of patients who have progressed satisfactorily. The patient is allowed up out of bed for the first time on the seventh day or later and like a bolt out of the blue, a fatal embolism occurs. Fortunately this accident is not very frequent however when it does occur it is grim tragedy.

Since muscular activity increases the venous circulation of the lower extremities, walking would prevent stasis in the venules of the muscles also since sitting or standing increases the caliber of the pelvic veins, stasis in the pelvic vessels associated with recumbency is thus removed. The prophylaxis afforded by early postoperative ambulation against such postoperative accidents should be quite apparent.

Early postoperative ambulation in plastic operations and vaginal hysterectomies causes no additional pain or discomfort. Patients who were ambulated early felt much more comfortable and invalidism was greatly decreased. Pain on sitting in a chair is avoided by the use of an inflated rubber cushion ring.

There may be some pain in the incisional area of abdominal operations on the initial attempt to arise, but this quickly subsides. The patients then feel more comfortable and from then on they have very few if any complaints about pain. Patients who had previous laparotomies in which they had been treated by the conservative regimen of late ambulation themselves volunteered the information that with early ambulation they had less discomfort and very little pain.

It has already been stated that a follow up of the patients treated by early postoperative ambulation in this report has revealed no wound disruptions, no incisional ventral hernias, no recurrent cystoceles, no prolapse of the vault of the vagina following vaginal hysterectomies and a study of the etiology of these conditions suggests no reason why early postoperative ambulation should result in a greater incidence of these conditions.

The breakdown of plastic operations or the prolapse of the vault of the vagina following vaginal hysterectomies may be entirely attributed to poor surgery or poor tissue, fascia etc. or both. Recurrent cystoceles or prolapse of the vault of the vagina following vaginal hysterectomies are seen frequently in patients who were ambulated late. Anatomically it is not conceivable that walking or sitting produces any significant stress or strain on the fascial supports of the bladder or rectum or the uterosacral and round ligaments which are used to support the vault of the vagina.

following vaginal hysterectomies. A cough or a sneeze in bed would cause more strain by the increased intra abdominal pressure thereby produced than would walking or sitting.

R A Cutting wisely stated that if unusual strains were a frequent cause of wound rupture the condition might well be expected to occur with a far greater degree of frequency than it does, because even though unusual strains be construed rather narrowly such strains occur far more frequently than wound rupture.

Brettner in 1899 was the first to describe wound disruption in the American literature, with a report of 3 cases. Several large series (3 8 10 11 12 21 24 28 29) have since then been reported. One is impressed with the variety of opinions as to etiology. There are many predisposing and precipitating factors suggested as being responsible for wound disruption.

The salient predisposing causes as evidenced by the many reports in the literature include the following obesity or asthenia (28) malnutrition (28) hypoproteinemia (13 15 26 28 30), avitaminosis (13 28) low ascorbic acid level (13 28 32) dehydration (28) diabetes mellitus and similar disturbances of sugar metabolism (32) malignancy (28) especially if previous radiation has been given and presence of acute or chronic pelvic inflammation (28).

The technique of wound closure is of obvious importance and various factors have been emphasized. Many have stressed in the technique of wound closure the significance with respect to the careless hemostasis (14 16) too tight suture of the fascia (6) the grasping of large masses of tissue in ligatures (18) excessive use of catgut (1) etc.

The salient precipitating factors, as evidenced by the many studies of evisceration are all conditions which increase the intra abdominal pressure (11 12 24 28 29). These include abdominal distention, with severe coughing or persistent emesis, hiccoughing etc.

The etiology (6 18, 19) of postoperative incisional ventral hernia is similar to that of wound disruption. Here, too poor operative technique and postoperative complications, such as abdominal distention associated with vomiting coughing and hiccoughing are stressed.

Considering all these factors, it is difficult to conceive that wound disruption or incisional hernia should occur more frequently with early postoperative ambulation than those treated by late ambulation. Predisposing causes of wound disruption or incisional ventral hernia such as malnutrition hypoproteinemia avitaminosis

scurvy (low ascorbic acid level) dehydration and so on should be eliminated by good preoperative care, a recognized necessity for all surgery. The importance of good operative technique in abdominal closure is taken for granted whether the patient is ambulated early or late. Should abdominal distention occur as a postoperative complication the surgeon's judgment should of necessity forbid the continuation of early postoperative ambulation, if already instituted, and appropriate measures should be taken to treat the cause of the distention.

It is interesting to note that in many reports in the literature, the incidence of wound disruption appears to be approximately the same as the incidence of fatal pulmonary embolism following surgery. In a study of wound disruption Schmitz and Beaton found an incidence of 0.18 per cent, Glenn and Moore (10) 0.66 per cent, Norris, 0.5 per cent, Singleton and Blocker 0.67 per cent, Barker *et al.* in a statistical study of pulmonary embolism, found that the incidence of fatal pulmonary emboli, associated with major gynecological surgery, ranged from 0.53 to 0.73 per cent. The mortality rate of wound disruption, however, appears to be at least 50 per cent less than that of pulmonary embolism. Bowen found that the mortality rate of wound disruption ranged from 16 to 75 per cent. The average reported mortality rate of wound disruption according to Schmitz and Beaton is 34.8 per cent. It seems logical, therefore, to employ early postoperative ambulation as prophylaxis against pulmonary embolism in spite of fear of wound disruption, which is unwarranted as has been indicated.

SUMMARY

Fifty four consecutive cases are reported the first 17 cases were maintained on the conservative regimen of late ambulation, the following 37 cases in the group received early postoperative ambulation.

1. The temperature and pulse rates showed relatively little significant change due to early ambulation.

2. Postoperative invalidism, both physical and physical, was markedly reduced in those patients ambulated early.

3. The nursing care requirements were markedly reduced.

4. No significant difference was noted in the requirements of postoperative catheterization in abdominal cases. In plastic operations and vaginal hysterectomies, however, an earlier return of bladder tonicity was suggestive in those patients ambulated early.

5. Those patients ambulated early were relatively more able to move their bowels without the aid of an enema.

6. Sedation was rarely required after patients were ambulated early.

7. The average number of hospital days required by the patients ambulated early was 8.71 days, by those ambulated late 13.04 days, thus saving an average of 5.32 hospital days per patient for those who were ambulated early.

8. The average convalescent period at home required by the patients ambulated early was 3.7 weeks by those ambulated late 6.5 weeks. The average total convalescent period required by those who were ambulated early was 3.3 weeks less than that required by those ambulated late.

9. A study of the etiology and pathology of postoperative pneumonia, atelectasis, pleurothrombosis, embolism, and infarcts indicates that early postoperative ambulation also offers advantages in prophylaxis.

10. Pain and discomfort as a result of early postoperative ambulation were not in evidence in this series. In fact, the patients who were ambulated early had less pain and discomfort than those who were ambulated late.

11. Early postoperative ambulation in plastic operations and vaginal hysterectomies should result in no greater incidence of recurrent cystoceles or prolapse of the vaginal vaults following vaginal hysterectomies. Anatomically there is no evidence of added significant stress on the fascial and ligamentous supports from early ambulation.

12. A study of wound disruption and incisional hernia suggests that early postoperative ambulation should not in itself result in a greater incidence of wound disruption and incisional hernia providing, of course, the patient has received good preoperative care and the usual good operative technique.

13. Follow-up in this series revealed no wound disruptions, no incisional hernias, no recurrent cystoceles, and no prolapse of the vaginal vaults following vaginal hysterectomies.

CONCLUSIONS

Early postoperative ambulation in gynecology reduces the usual postoperative invalidism, both physically and physically and results in a more rapid convalescence. Gastrointestinal and bladder tonicity may be increased. Very little, if any sedation is required after early ambulation is instituted. Nursing care is markedly reduced. There is an increased economy for the patient.

There is a definite advantage in early ambulation as prophylaxis against postoperative post-

monia, atelectasis, phlebothrombosis embolism and infarcts. Early postoperative ambulation *per se* should in no way increase the incidence of wound disruption, postoperative incisional hernia, recurrent cystoectoceles following plastic operation or prolapse of the vaginal vault following vaginal hysterectomies.

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EDITORIAL

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IPSILATERAL SPASTIC RECTUS ABDOMINIS IN A PURELY THORACIC WOUND

OBSERVATIONS on wounds of the thorax within the first few hours after injury have yielded some interesting side lights on these dangerous wounds. In one action resulting in 250 deaths on the battlefield 60 deaths or approximately 25 per cent were due to wounds involving mainly the chest. Death from chest wounds on the battlefield or at the forward dressing station occurs most frequently due to massive hemorrhage from injuries to the heart the aorta the vena cava the hilar vessels or even to the subclavian vessels running over the apex of the lung. If the wounded man survives the threat of immediate hemorrhage and can be transported to an evacuation hospital his chances for survival are greatly increased but even here death from exsanguination may still occur although in decreasing numbers as pooled universal group O blood

and massive transfusions are made as readily available as plasma.

A second cause of early death is a tension pneumothorax incident to a laceration of the lung or of a bronchus, which may open as the lung relaxes in expiration. The obvious dyspnea the immobile but distended hemithorax the resonance on percussion and absence of breath sounds, give clear evidence of the need for prompt withdrawal of air but not infrequently the need for the continuous escape of air is unrecognized and death from respiratory and circulatory failure occurs. A patient who has had one aspiration for a tension pneumothorax with removal of apparently sufficient air to correct the mediastinal displacement must be under careful and repeated observation for the next 48 hours lest a recurrence of the pneumothorax be overlooked. The introduction of a needle or of a catheter into the chest for the continuous escape of air should not be approached with timidity even by surgeons inexperienced in thoracic work. If an underwater seal or a flutter valve is also provided, one need have no hesitancy in producing such a temporary opening into the thoracic cavity.

A fascinating but poorly understood early observation in connection with wounds limited to the chest has been an accompanying abdominal wall rigidity usually unilateral, occasionally bilateral and often associated with subcostal tenderness on palpation and percussion strongly suggesting an intra-abdominal injury. There is also absence or markedly reduced amplitude of excursion of the abdominal wall during respiration suggesting an immobile or spastic diaphragm or even an

underlying peritonitis. Frequently these signs are present only in the early hours after injury, they disappear spontaneously some times within 18 hours and they rarely persist more than 48 to 72 hours. In the first few hours after injury they may be so pronounced that one might easily be tempted to perform an abdominal exploration for a ruptured viscus.

Occasionally in association with through and through wounds of the lower right chest, the right diaphragm and dome of the liver may sustain an injury which is quite unsuspected before its disclosure at operation or at autopsy with a resulting rigidity of the abdominal wall and tenderness of the entire abdomen due to the irritating effect of bile and blood in the peritoneal cavity.

It is not uncommon of course, to find such abdominal spasticity and subcostal tenderness on the same side as a lower lobe pneumonia attributable to involvement of the diaphragmatic pleura in the inflammatory process. In the cases under discussion there was no injury to the diaphragm and no inflammation except that incident to blood in the pleural space. In one case autopsy served to illustrate the frequently observed phenomenon of a spastic abdomen associated with injuries entirely limited to the chest.

A number of nonfatal cases could be cited illustrating the effect upon the abdominal wall of purely thoracic injuries. Conversely similar phenomena involving the uninjured chest, consecutive to wounds of the abdomen have also been observed. What operator has not noted following a McBurney incision or a right rectus incision or a wound of the flank, a definite lag in respiration, a limitation in the excursions of the chest and diminished breath sounds on the side of the wound even with no evidence of bronchial obstruction or atelectasis to explain it?

In one instructive instance three observers independently concluded that a private with a large left flank wound draining feces through a tangential laceration of the colon had a left subphrenic abscess due to high fever, diminished respirations, faint breath sounds, dullness suggesting a high diaphragm and tenderness on heavy percussion of the left lower chest. When no pus was found on aspiration at several points the wound itself was widely opened, and a large piece of shrapnel and sequestered bone were removed from a lumbar abscess followed by complete disappearance of all chest signs.

A connecting link between the two serous lined cavities is the sympathetic chain but the mechanism whereby it acts is unknown due to our limited knowledge of the sympathetic pathways and the direction of their impulses. The intercostal nerves may be part of a reflex arc capable of mediating painful stimuli from the site of injury and affecting the abdominal wall innervated by them. A third possible explanation lies in the irritating effect of free blood in the pleural space upon the parietal and diaphragmatic pleura and upon structures which are unaccustomed to its presence. The early disappearance of this effect may be the result of dilution of the blood through pleural weeping. Whatever its explanation this highly interesting reciprocal relationship between the two major serous lined cavities of the body and how it is mediated should yield to carefully planned experimentation.

Surgeons generally should be aware that in the presence of a chest wound, a spastic tender abdomen does not necessarily require a laparotomy and if clinical and x-ray studies definitely disclose that the missile in its line of flight did not traverse the abdomen or its parietes one may safely disregard the abdominal signs.

EMIL HOLMAN

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

THE book by Clement A. Smith, *The Physiology of the Newborn Infant* is a monograph which deserves more than passing notice. Pediatricians and obstetricians particularly will find it useful. Lack of a source book of information on this subject has long been felt. New clinical observations and scientific research during the last few years have added much to knowledge in this field and have made all previous accounts of neonatal physiology obsolete. The present text assembles these data.

The text concerns itself with the period of the newborn and its transition from fetal life. The subjects of respiration, circulation, blood, metabolism digestion, assimilation renal physiology endocrinology and immunology are treated. Thus it is quite a complete treatise of neonatal physiology with the exception of the nervous system and sense organs. The author states that the absence of the section devoted to the nervous system is not an oversight most of the available knowledge upon that subject, he points out, is limited to the fetus or is anatomical in nature or considers the newborn period only briefly in relationship to general neuromuscular development. It is indeed true that physiology of the nervous system at the time of birth and during the first few months of life is a *terra incognita*.

The author himself has contributed scientifically to a number of the subjects dealt with in his book. Thus he writes with great insight. The reviewer was especially pleased with the chapters on respiration and circulation. However each succeeding chapter of the book is so full of new and important information that it seems more important than the preceding one. None is dull each makes good reading.

One of the outstanding features of Professor Smith's monograph is the presentation at the conclusion of each chapter of a clinical summary in which the scientific data are discussed briefly from the standpoint of practical medicine. It is these summaries which make the book so useful to the clinical reader. Another interesting summary is found in a table printed on the back inside cover. This is a table of normal values at birth and on succeeding days thereafter. It serves as a ready and handy reference synopsis. Excellent bibliographies appear at the end of each chapter.

The Physiology of the Newborn Infant is very attractively printed and bound. It is not a large book. The text including the index occupies only 312

pages. Great credit is due the author for getting into such small volume so very much useful and interesting material.

WILLIAM F. WOOD.

THE third edition of *Fractures of the Jaws* by Ivy and Curtis² will be received with proper appreciation by all who have to deal with maxillofacial surgery. The writing is clear and concise, and the subject matter carries the authority based on years of personal experience. The authors describe their own successful methods and also those of contemporaries in a generous manner. The character of the text remains the same, however various new techniques and methods of fixation have been added.

We would particularly draw attention to the sections on roentgenographic technique and dietary management. These two important adjuncts to the successful treatment of jaw fractures cannot be too highly commended. Proper attention to these precepts will facilitate reduction of the fracture and recovery of the patient.

This compact book is well and profusely illustrated and it is a pleasure to suggest that every dentist, maxillofacial and general surgeon would profit by adding it to his library to read, study and have available for ready reference.

FREDERICK W. MURPHY.

THE *Primer of Electrocardiography*³ by George Burch, M.D., and Travis Winsor, M.D. describes in detail the fundamentals of electrocardiography. In the strict sense the title is somewhat misleading for the book goes into more detail than the word 'primer' would lead one to believe. On the other hand, the authors probably felt that this was apropos inasmuch as only the basic considerations of this diagnostic procedure were covered. Through the liberal use of diagrams, each point is adequately exemplified. The theories of electrocardiography, precordial leads, and diseases of the heart beat are well covered. The chapter on the clinical significance of the various components of the electrocardiogram is well written and will be of definite value to the beginner. It will also serve as a handy reference to those who are more thoroughly versed in electrocardiography as it contains many details which cannot be found in books stressing interpretation. Although no photographs of actual electrocardiograms are included the important

¹FRANCHESCHI OF THE JAW By Robert H. Ivy, M.D. D.D.S., F.A.C.S. and Lawrence Curtis, A.D. M.D. D.D.S. F.A.C.S. 3rd ed. Philadelphia: Lea & Febiger 1942.

²A PRIMER OF ELECTROCARDIOGRAPHY. By George Burch, M.D. F.A.C.P. and Travis Winsor, M.D. Philadelphia: Lea & Febiger 1941.

³THE PHYSIOLOGY OF THE NEWBORN. By Clement A. Smith, M.D. Springfield, Illinois: Charles C. Thomas 1943.

changes occurring in various types of heart abnormalities are adequately demonstrated. When used in conjunction with a manual stressing interpretation it should prove helpful in the study of electrocardiography.

T. R. VAN DELLEN

THE second edition of a very clear and practical book on *The Intervertebral Disc* by Bradford and Spurling brings up to date our knowledge of this subject and places special emphasis on the clinical and neurological diagnosis of herniation of these discs. Growth and mechanical factors are discussed in the first chapter with emphasis on the great anterior hydraulic compressive force placed upon the nucleus pulposus of the fourth and fifth lumbar discs in forward lifting strain. Pathology associated with age change is considered an important factor in disc herniation although sclerosis, narrowing and vertebral hypertrophic changes are not commonly related to nucleus pulposus herniation.

The clinical study of patients with "low back and sciatic pain" is very well presented except that there is continued confusion in reference to pain or "sciatica" along the course of the great sciatic nerve and lack of clear definition of symptoms and signs of single nerve root distribution. It is regrettable that these authors who have been leaders in the emphasis of neurologic diagnosis and unnecessary use of the spinoqram should be unable to present any consistent dermatome pattern in the lower extremity and continue to use the somewhat untimely and authoritative Tilney and Riley for illustrations of dermatome patterns. These charts were taken from Dejerine (1914) without any very evident original work to support them, and certainly are outdated by the more authoritative work of Foerster (1933). The irregularity of the areas of hypesthesia in clinical cases illustrated in this book denotes inaccuracy of technique in plotting these areas. Also there are conflicting statements about the occurrence of sensory loss in association with single nerve root involvement the authors tending to adhere to Foerster's dictum that this does not occur but citing a high percentage (75 per cent) of detectable hypesthesia in proved herniated nucleus pulposus cases with admitted single nerve root involvement. Better technique is needed on this subject as others are able to outline consistent diagnostic areas of dermatome hypalgesia from unquestionable single nerve root loss.

The roentgenological presentation calls attention to the usual lack of diagnostic findings of herniation of the nucleus pulposus except by myelography or the spinoqram. The authors very properly reserve the use of the spinoqram to atypical or doubtful cases in which localization cannot be made by history and neurologic signs calling attention to the possible complications and uncertainties of intraspinal foreign media.

1. INTERVIEW BY AL. HING, WITH SPECIAL REPORTS BY TO. RUTHERFORD OF THE ARMY, 1. 1900. WITH 11 ILLUSTRATIONS OF THE SPINOGRAM. BY F. K. B. BRADFORD, M.D. and R. G. SPURLING, M.D. 1940. Springfield, Illinois: Charles C. Thomas. 945.

Distinction is made in the application of manipulation therapy. It often being beneficial in early cases with predominant midline low back pain but liable to do harm in longer continued cases with entirely lateralized nerve root pain indicative of irreducible herniation. These latter cases may improve under long continued conservative rest or orthopedic treatment due to subsidence of acute swelling or in a destroyed insensitive nerve root. Surgical treatment by very limited hemilaminectomy carries less than 1 per cent risk does not significantly weaken the supporting structure of the back and offers immediate relief of the lateralized nerve root pain. A more conservative attitude is held when low back pain predominates as spinal fusion then may be necessary. Single nerve root section may be done to free a nerve from fibrotic adhesions and leaves no disabling functional loss.

The final discussion is interesting in the critical analysis of other reports. The authors consider it now well established that total involvement of either the 5th lumbar or 1st sacral nerve will usually produce objective sensory changes contrary to Foerster's dictum, while on a later page they state involvement of only one nerve does not often produce hyperesthesia. Dandy's contributions on concealed discs and surgical excision of discs are considered not well founded. Primary sciatic neuritis and sacral strain are called clinical curiosities. Kelgren's dermatome pattern of referred pain from interspinous ligament injection is commended for its dermatome localization but on the preceding page the authors state that localized pain is not very reliable in identifying the roots involved by herniation of nucleus pulposus. The orthopedic idea that narrowing of the 5th lumbar intervertebral foramen commonly causes nerve root pain is negated by the usual finding of a herniated nucleus pulposus compressing the 5th nerve root when symptoms of this root involvement are present. It is stated that there can be no doubt that the incidence of anomalies is greater in a series of patients complaining of low back and sciatic pain than in a control series. Inasmuch as this condition seems to predispose to nucleus pulposus herniation although in itself does not cause nerve root symptoms.

Cervical herniations are presented somewhat briefly but with emphasis on the recent establishment of small lateral herniation in the lower cervical region as a common cause of pain radiating from the neck over the shoulder and into the arm and hand with subjective sensation of paresthesia or numbness. As in the leg the pain and numbness follow a compressed single nerve root distribution and hypalgesia or hypalgesia may be demonstrated. Surgical relief can be given, as in the lumbar herniation after trial of conservative measures. Occasionally will cause herniation of annulus as well as nucleus will cause cord or cauda equina compression and demand prompt relief by surgical procedure.

J. JAY KEEGAN.

THE author of *Acute Injuries of the Head* is one of the leading neurosurgeons of England. By training surgical background, and large personal experience in the field of craniocerebral injuries he is thoroughly qualified to write on the subject of head injuries.

The book is addressed to the general practitioner and the general surgeon whom the author regards as vital links in the care of patients with cranial injuries. The subject of craniocerebral injuries has been covered from every angle in this book. The chapters on the mechanisms of injury and pathology are splendid. Those portions of the book describing technical procedures and operations are clearly written and generously illustrated. Posttraumatic sequelae are thoroughly dealt with. The author has given very thoughtful, realistic discussion of the organic and the functional factors contributing to the typical postconcussion syndrome with helpful guides for expressing the relative rôle played by these two factors in any patient. Principles of treatment described in the book will have the approval of most neurosurgeons. This reviewer differs with the author's opinion regarding the value of subtemporal decompression and repeated spinal drainage in the treatment of closed head injuries but it must be recognized that these are still unsettled issues. The author's style of writing is pleasing and invites further reading. He tends to avoid generalizations and prefers to make his points by numerous well chosen illustrative case records.

If any criticism were to be made of the book it would be in regard to the arrangement of subject matter. The book might be improved a bit, in the reviewer's opinion, by a change of certain chapter headings. For instance, Chapter III which is titled "Diagnosis" might better be titled "Clinical Manifestations and Typical Clinical Syndromes." Again, the arrangement of subject matter might be improved in one or two places. For instance, the chapter on pathology deals only with pathology of cerebral injuries, whereas the pathology of cranial fractures is dealt with in a subsequent part of the book, describing the treatment of these fractures. At another place in the book, under the subject heading of "Spinal Puncture," the author digresses far enough to discuss treatment of primary shock, transfusion, the management of associated visceral wounds, and the excision of compound fractures. At another place in the midst of a chapter on diagnosis the author consumes one full page in discussing the indications for subtemporal decompression. The discussion itself is entirely proper but the place in which the author has introduced it in the book appears to me untimely.

These are of course minor considerations judged against the general excellence of the subject matter and can be corrected in subsequent editions. The book is of comfortable size and pleasant to handle.

ACUTE INJURIES OF THE HEAD, THIRD EDITION, T. KENTWORTH COOPER, THOMAS W. BRIDGES, BY G. F. ROBERTSON, M.Sc. (Manc.) F.R.C.S. (Eng.). Foreword by Norman M. Dott, M.B. Baltimore, Md. Williams & Wilkins & Co. 1945.

Paper and printing are good. Illustrations are numerous and excellent. The author in his preface to the second edition, says "I believe that any general practitioner will find perusal of this book not only valuable, but will find the subject interesting and even exciting. With that opinion, I concur."

JOHN E. SCARRY

THE fourth edition of Kuntz' *A Textbook of Neuroanatomy*¹ follows the traditional pattern of introducing the gross topography of the nervous system with comparative and embryological sections then of reviewing the histology of nervous tissue and proceeding from peripheral nerve into the spinal cord to mount by several stages through the brain stem and emerge at the cerebral cortex. Within the limits imposed by such a repeated approach, in which, for example, consecutive chapters are devoted to nuclear connections of the cranial nerves, the cerebellum, the diencephalon, the optic connections and the autonomic nervous system, the author presents a clear description of neuroanatomy without excessive detail and with a concise summary at the end of each chapter. This last unusual feature will doubtless be greatly appreciated by the hard pressed medical student of today.

Passing reference to the functional and clinical significance of structures is made throughout the text and an entire chapter is devoted to that of the cerebral cortex. A laboratory guide is appended, together with a series of case histories illustrating the clinical aspects of injuries to the peripheral nerves, spinal cord and brain. Because all the brain lesions resulted from vascular disturbance the student may wonder why no reference to the blood supply of the nervous system was incorporated in the text.

H. W. MASON

IN the third edition of Kuntz' *The Autonomic Nervous System*² presentation of the general anatomy and physiology is succeeded by detailed discussions of the innervation of each of the organs, visceral pain, histopathology, disease, and autonomic neurosurgery. Specific citation of original articles is a constant feature and the one hundred twenty pages of assembled references constitute a unique bibliography in the many aspects of this field.

In the preface mention is made of the temptation to give undue weight to recent contributions that is resisted in varying degrees to preserve a balance between the new and the old. The reviewer is one who would like to have seen this resistance relaxed in the discussion of such topics as the terminal reticulus and ground plexus and the sympathetic innervation of skeletal muscle.

The book is recommended as a valuable reference work to everyone interested in the autonomic nervous system.

H. W. MASON

A TEXTBOOK OF NEUROANATOMY. By Albert Kuntz, Ph.D. M.D. 4th ed. Philadelphia: Lea & Febiger, 1945.

THE AUTONOMIC NERVOUS SYSTEM. By Albert Kuntz, Ph.D. M.D. 3rd rev. ed. Philadelphia: Lea & Febiger, 1945.

THE work described in *Pulmonary Tuberculosis in the Adult* by Max Pinner¹ is a welcome addition to the tuberculosis literature. The material has been wisely selected from the welter of divergent viewpoints and connected or really folded into a unit that is clearly presented easy to read and understand, and one that compels an absorbing interest in the subject.

Doctor Pinner states in the preface that he does not pretend to have written a textbook or a guide to treatment or diagnosis, but aims more to stimulate interest in the form of an introduction to the dynamic process of tuberculosis. His purpose has been fully realized. In addition to the many fascinating essays on the disease the author has given a valuable collection of short abstracts of important articles on the various topics.

No worker in tuberculosis or chest diseases should be without this book, although the work does not save, nor pretend to have anything but general usefulness for the surgeon.

The illustrations are adequate properly chosen and well reproduced. The type, printing paper and binding are worthy of the high standards already set by the publisher.

HENRY C. SWANBY

THE third revision by Stander of *Textbook of Obstetrics*² represents the ninth edition of *Williams' Obstetrics* but it is published under the present author's name since, as he states in the preface it embodies his teaching and practice and therefore he assumes full responsibility.

This volume consists of 1200 pages of subject matter with over 700 well chosen illustrations. The first 500 pages deal with the anatomy of the female pelvis, physiology, development of the fetus and changes occurring therewith endocrine function and their practical applications in obstetrics, and the conduct of pregnancy and labor. An excellent review of the subject of analgesia and anesthesia is included. The following 700 pages are devoted to the pathology of pregnancy and operative procedures, puerperium. Abnormal pelvis and abnormal pelvis are considered here. The sections on toxemia, extrauterine pregnancy and abnormal pelvis are particularly comprehensive and embody the latest contributions on these subjects. One important omission, however is noted under the Hillis impression method, namely the Hillis impression method. All other methods for attempting to determine the relationship between the size of the fetal head and the maternal pelvis are described. The Hillis impression method since it is the simplest and without the objection of vaginal manipulation, is by far the most practical and useful of all such methods, and should therefore, be included in all obstetrical textbooks.

Stander's third revision of *Williams' Obstetrics* brings it up to date with such recent advances as the importance of the Rh factor in obstetrics and the addition of penicillin and the sulfonamides to the obstetrician's armamentarium but it also retains the simplicity of style and the clear concise presentation of the subject that has characterized this text in previous editions.

CHARLES C. DOWNEY

THE volume entitled *The Osseous System*³ is the fourth of a series of handbooks of roentgen diagnosis being published by the Year Book Publishers. As in previous volumes the material is so arranged that the illustrations and legends on the opposite page and the description and legends on the opposite side. The concise but lucid subject matter is illustrated by 432 figures on 148 plates all in the negative phase. Throughout the text, the author emphasizes the pitfalls of diagnosis and urges that the occasional radiographer always think of the maximum. What might it be besides what I think it is?

The contents of the volume is divided into five sections technique principles of interpretation roentgen anatomy injuries to the skeletal system other than the spine bone diseases occurring abnormalities in childhood bone diseases occurring principally in adult life. A short bibliography appears at the end of each section and an adequate index is appended.

This volume is a handy sized modestly priced atlas and can be recommended to general practitioners surgeons and internists as a diagnostic aid. It should be regarded as indicated as a primer rather than an encyclopedia.

EARL E. BARTT

THE author of *Electrotherapy and Light Therapy*⁴ is an outstanding authority in the field of physical medicine. The fifth edition of this work offers a concise presentation of all present day phases of physical medicine with special emphasis on electrotherapy and light therapy. The newer uses and methods of electronics, electrodiagnosis, ion transfer and ultraviolet radiation have all been incorporated. The chapter on exercise has been considerably enlarged and a new chapter on hypothermy has been added together with a revised glossary covering definitions of electrotherapy and light therapy muscle and nerve action and mechanotherapy. Each chapter has been brought up to date. New illustrations have been added and obsolete ones omitted. The illustrations are excellent.

One of the peculiar features of the book which has enabled it to maintain a position of leadership for fifteen years, is the interesting manner in which the subject is presented. It contains much valuable information, and it is a safe guide to the practitioner's hands of the practitioner.

JOHN S. COULTER

PUBLISHED BY THE YEAR BOOK PUBLISHERS, INC., 1365 NORTH DEARBORN ST., CHICAGO, ILL. 46
 BY MAX PINNER, M.D., Springfield, Ill. Use of 8 1/2 by 11 inch size
 TEXTBOOK OF OBSTETRICS, (formerly by WILLIAMS) By HENRY C. SWANBY
 PUBLISHED BY THE YEAR BOOK PUBLISHERS, INC., 1365 NORTH DEARBORN ST., CHICAGO, ILL. 46
 M.D. F.A.C.S. Stander's 3rd rev. New York and London: D. Appleton-Century Co. Inc. 945

ST. OMER'S SYSTEM, CHICAGO, ILL. 46
 VICTOR W. ARCHER, M.D. CHICAGO, ILL. 46
 ELECTROTHERAPY AND LIGHT THERAPY, WITH TEXT, E. BARTT, M.D.
 HYPERTHERMIA AND MICROANATOMY, BY RICHARD KOWICZ, M.D.
 5th rev. ed. Philadelphia: Lea & Febiger 945

THE subject of this book is physiology not physics from above but physiology from below' not physiology originating essentially to fill human needs and help suffering individuals but physiology as a branch of physical chemical sciences dealing with life as a physical, though exceedingly complex system, that may be subjected to scientific analysis like any other natural object." Quotation is from the preface of *Physical Chemistry of Cells and Tissues* by Rudolf Hoebner et al.

The reviewer is very rough in sympathy with the aims of this book. American science in general, is far too concerned with "practical applications." Nature is a lady who must be wooed for her own worth before she will reveal herself. Certainly there is a tremendous need for such a book as we have here and a still greater need for people with the viewpoint of the authors of this excellent text. It is a book which must be bought by all who wish to understand what is now known about many important phases of life processes.

The first 91 pages were written by David I. Hitchcock and deal essentially with physical chemistry of solutions. He discusses diffusion in solution, reaction velocity thermodynamics, electromotive force, osmotic pressure, electrokinetics and distribution coefficients. Hitchcock stays on broad and well trodden highways. This section is clearly written but parts of it are very scratchy and rather thin. For example, the reviewer doubts that a reader who is not already familiar with thermodynamics could profit very much by reading the chapter on this subject too much territory is covered in the 13 pages. This brevity is carried to extreme in the discussion of dielectric constants, dipole moments and the Debye Hückel theory of strong electrolytes. Two pages are devoted to these subjects!

Section 2 which covers 120 pages was written by J. B. Bateman. In this section Bateman deals with molecular forces, determination of sizes and shapes of large molecules, hydration, protein structure, x-ray diffraction analysis, the structure of crystals and fibers and surface monolayers. There is much excellent material in this section. The part dealing with crystal structure is especially informative. Bateman covers many complex subjects and the reviewer appreciates the great difficulty of presenting these topics simply but it must be said that this section suffers from a lack of clarity.

The strictly biological part of the book begins with Hoebner's section (141 pages) which deals with the penetration of cell membranes by organic non-electrolytes by electrolytes by weak acids and bases by dyestuffs by water and finally he considers the chemistry and physics of plasma membranes. He brings to these subjects more than 40 years of experience and he has performed a great service to all of us by summarizing with completeness and detail the existing knowledge about cell membranes. Hoebner

follows the Collander and Baerlund "lipoid-sieve theory" of cell membranes. He discusses active and passive uptake of substances and describes how they can be distinguished from each other. One cannot help but have the feeling after reading this section that future progress in the study of cell penetration must involve a fuller consideration of the interior of cells. It appears that the penetration and action of narcotics is very obscure and would especially benefit by such expansion.

A section has been contributed by David R. Goddard (71 pages) on the respiration of cells and tissues. Goddard's section is simply written, clear and up-to-date. He deals with the rate of respiration as limited by the rate of diffusion of oxygen. The kinetics of activated reactions are discussed and there is a short chapter on the nature of oxidation, he discusses respiratory enzymes. There follows a chapter on the relation between fermentation and respiration. Finally there is a chapter on the utilization of liberated energy. This last is by necessity very incomplete since our knowledge of this utilization is at the present exceedingly imperfect.

W. O. Fenn has 75 pages on contractile tissues with special reference to striated and smooth muscle. This is a well balanced and critical review of experiments and theories of muscle contraction. It appears from this review that there still remains much to be known about muscle contraction. Muscle physiology has passed through several phases until now it has become a sophisticated science and one has to have a background in several branches of science to appreciate all the modern developments. One can, however, note considerable recent progress and as Fenn writes, "At last the contractile machinery has become more than a structure which is passively acted upon by lactic acid or some other metabolic product. It is as if steam had at last been admitted to the previously empty cylinders of the muscle machine."

Hoebner concludes the book with a section (170 pages) on passive and active transfer in animal and plant tissues. In this section he deals with intestinal absorption, formation of urine, permeability of body surfaces of animals and plants, formation of digestive juices and finally a discussion of some of the mechanisms which may be involved in active transfer. Here again as in the section on cell membranes there is a wealth of detail.

HENRY B. BELL

THE fourth edition of Christopher's *A Textbook of Surgery*, an already well established standard text by eminent American authors, has been made an even more complete and currently correct basic volume for students and reference point for practitioners. This has been accomplished through the addition of sections devoted to recent military experiences as well as the modification of other sections on the basis of progress in both civilian and military surgery. In view of the cautiousness of publi-

cation following the end of World War II remarkably few statements will require considerable correction as a result of reports on military observations made available subsequent to completion of the

present edition. This volume maintains the high standards of format and illustration which characterized previous editions of the work.

AMROSE H. STORCK.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

TRATAMENTO CIRURGICO DO CANCER DA MAMA. By Alberto Francis Martins, M.D. Vol. 3, Nos. 9 and 10. Sao Paulo, Brazil: Revista de Medicina e Cirurgia de Sao Paulo, 1943.

TRATAMIENTO DE LAS ULCERAS PERFORADAS DEL ESTOMAGO Y DUODENO. By Julio A. Acebal, M.D. Rosario, Brazil: Libreria y Editorial Ruiz, 1943.

SURGICAL NURSING. By E. L. Eliason, A.B., M.D. Sc.D., F.A.C.S., L. Kraeger Ferguson, A.B., M.D., F.A.C.S., and Evelyn M. Farrand, R.N. B.S. 7th ed. Philadelphia: J. B. Lippincott Co., 1945.

TRANSACTIONS OF THE AMERICAN GYNECOLOGICAL SOCIETY. Edited by Howard C. Taylor Jr. M.D. Vol. 68. St. Louis: The C. V. Mosby Co., 1945.

NITROUS OXIDE-OXYGEN ANESTHESIA. McKesson-Clement Viewpoint and Technique. By F. W. Clement, Major M.C.(A.U.S.) 4th ed. Philadelphia: Lea & Febiger, 1945.

THE EXTREMITIES. By Daniel P. Quiring, Ph.D. Beatrice A. Boyle, Erna L. Borouh, M.A., and Bernadine Lufkin, A.B. Philadelphia: Lea & Febiger, 1945.

ATLAS OF SURGICAL APPROACHES TO BOWEL AND JOINTS. By Toussaint Nicola, M.D., F.A.C.S. Foreword by Norman T. Kirk, Major General, U.S. Army. The Surgeon General, New York: The Macmillan Co., 1945.

AN INTRODUCTION TO CLINICAL SURGERY. Surgical Wherefore and Therefore. A Reasoned Explanation of Surgical Note-Taking. By Charles F. M. Saint, C.B.E., M.D. M.S., F.R.C.S.(Eng.) F.R.A.C.S. Cape Town: The Post-Graduate Press by The African Bookman, 1945.

Men Without Guns. Text by DeWitt Mackenzie, War Analyst of The Associated Press. Descriptive Captions by Major Clarence Worden, Medical Department of the United States Army. Foreword by Major General Norman T. Kirk, Surgeon General of the United States Army. Illustrated with 37 Plates from the Abbott Collection of Paintings Owned by The United States Government. Philadelphia, Toronto: The Blakiston Co., 1945.

FRATURAS—LUXAÇÕES TORCIDAÇÕES. By Renato Da Costa Bonfim. São Paulo: E. G. Revista dos Tribunais Ltda., 1945.

INDUSTRIAL TOXICOLOGY. By Alice Hamilton, A.M. M.D. and Rutherford T. Johnstone, M.D. Edited by Henry A. Christian, A.M. M.D. LL.D. Sc.D. (Hon.), F.A.C.P. Hon. F.R.C.P. (Can.) Reprinted from Oxford Loose Leaf Medicine. New York: Oxford Univ. Press, 1945.

GYNECOLOGIC NURSING. By Robert James Crossen, A.B. M.D. F.A.C.S., and Frances W. Hoffert, R.N. B.S. 3d ed. St. Louis: The C. V. Mosby Co., 1946.

SURGICAL TREATMENT OF THE MOTOR SKELETAL SYSTEM. By Frederic W. Bancroft, A.B. M.D., F.A.C.S., and Clay Ray Murray, M.D. F.A.C.S. Parts 1 and 2. Philadelphia, London, Montreal: J. B. Lippincott Co., 1945.

BIOLOGICAL ACTIONS OF SEX HORMONES. By Harold Burrows, C.B.E. Ph.D. F.R.C.S. Cambridge: The University Press, 1945.

SYNOPSIS OF GYNECOLOGY. Based on the Textbook Diseases of Women. By Harry Sturgeon Crossen, M.D., F.A.C.S., and Robert James Crossen, M.D. F.A.C.S. 3d ed. St. Louis: The C. V. Mosby Co., 1946.

EL HONOR NUESTRO TEMA MEDICOLOGICO. By Prof. Dr. Pedro Belloc. Buenos Aires: La Semana Medica, 1945.

HOMENAJE AL PROFESOR PEDRO BELOC. Buenos Aires: Guillermo Kraft Ltda., 1945.

THE CHEMISTRY OF ANESTHESIA. By John Adriani, M.D. Springfield, Ill.: Charles C. Thomas, 1946.

BRECHTSTERN PAPERS. Edited by Jack Penn, M.B.E., M.B. ChB. F.R.C.S.E. Johannesburg: Witwatersrand University Press, 1944.

THE PHYSIOLOGICAL BASIS OF MEDICAL PRACTICE. By Charles Herbert Best, C.B.E., M.A., M.D., D.Sc., F.R.S. F.R.C.P., and Norman Burke Taylor, V.C., M.D., F.R.S. F.R.C.S., F.R.C.P., M.R.C.S., L.R.C.P. Baltimore: The Williams & Wilkins Co., 1945.

ROENTGEN DIAGNOSIS OF DISEASES OF THE GASTRO-INTESTINAL TRACT. By John T. Fittell, Jr., M.D. Springfield, Ill.: Charles C. Thomas, 1946.

IRISH MEDICAL DIRECTORY AND HOSPITAL YEAR BOOK. 8th ed. Dublin: The Parkside Press Limited, 1945.

CLINICAL ELECTROCARDIOGRAPHY. By David Scherf, M.D. F.A.C.P. and Linn J. Boyd, M.D., F.A.C.P. Philadelphia: J. B. Lippincott Co., 1946.

NUTRITION AND CHEMICAL GROWTH IN CHILDHOOD. Vol. 2. Original Data. By Ide G. Macy, Ph.D., Sc.D. With a Foreword by Lawrence Reynolds, M.D. and a Supplement by Julia Outhouse Holmes, Ph.D. Springfield, Illinois: Charles C. Thomas, 1946.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

W EDWARD GALLIE, *President*

IRVIN ABELL, *Louisville President-Elect*

Committee on Arrangements

HOWARD PATTERSON *Chairman* FRANK GLENN *Secretary*

PRELIMINARY PROGRAM FOR 1946 CLINICAL CONGRESS NEW YORK, SEPTEMBER 9 TO 13 1946

THE thirty-second Clinical Congress of the American College of Surgeons will be held in New York City at the Waldorf Astoria from September 9 to 13. This will be the first Congress since the 1941 meeting in Boston. Between 1942 and 1945 the Congress was voluntarily cancelled each year in order to lessen the transportation difficulties and to conserve the time of medical and hospital personnel who were overburdened because of the absence of so many of their associates on duty with the armed forces. By autumn the majority of these will have returned and the time seems most auspicious for a great postwar Congress. The preliminary announcement of the plans has been received with enthusiasm by both the military and civilian groups.

CLINICAL PROGRAM

Under the leadership of a strong and representative Committee on Arrangements, plans are under way for a complete and varied program for the five day meeting. The hospitals and medical schools will co-operate in scheduling operative and nonoperative clinics and demonstrations.

COMMITTEE ON ARRANGEMENTS

Howard Patterson,
Chairman
Frank Glenn, *Secretary*
Frank Adair
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E. Jefferson Browder
George F. Cahill
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J. William Hinton
George H. Humphreys
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John H. McIlholland
W. Barclay Parsons
Otto Pickhardt
Thomas H. Russell
Raymond P. Sullivan
Howard C. Taylor, J.
William Crawford White
Philip D. Wilson

Visiting surgeons will have ample opportunity to attend well arranged programs of many different kinds in several of the excellent hospitals in the Greater New York area. These programs will include general and special demonstrations such as fractures, cancer, maternal morbidity and end-result studies, clinicopathologic and x-ray conferences, newer diagnostic and therapeutic procedures, preoperative and postoperative supportive treatment, anesthesia and reconditioning. Those interested in operative clinics will have an opportunity to observe newer techniques and surgical procedures. A series of exhibits demonstrating the work of the medical schools and their affiliated hospitals will be available for study in the local hospitals during the meeting, and the basic science departments of the medical schools will present graphic descriptions of their work.

The program of each hospital will be arranged to cover subjects in general surgery, obstetrics and gynecology, fractures, orthopedic surgery, thoracic surgery, neurosurgery, genitourinary surgery, ophthalmology and otolaryngology. A daily clinical bulletin will be published to show the presentation of subjects under these classifications so that the visiting surgeon may select the programs which he wishes to attend.

CONVOCATION AND PRESIDENTIAL MEETING

The opening evening session of the Clinical Congress will be devoted to the combined presidential meeting and convocation. Since the last Congress in 1941 a total of 2,744 surgeons have been received into fellowship *in absentia*, and to them in particular the Convocation on the opening night of the Congress will be a long anticipated event. Many of these new Fellows have been

AMERICAN COLLEGE OF SURGEONS

serving with the armed forces. The formal initiation ceremonies, always impressive, will be exceptionally so this year because of the large number of new Fellows accepted during the past four years who are expected to be present, in addition to the 1946 group of initiates.

Officers, Regents, and Governors have remained in office since 1941 because of the cancellation of annual meetings of the Fellows and Governors. Especial interest will also therefore be attached to the installation of the officers-elect consisting of Dr Irvin Abell of Louisville, chairman of the Board of Regents as president Dr Leland S McKittrick of Boston as first vice president and Dr F Phinizy Calhoun of Atlanta as second vice president.

Dr W Edward Gallie of Toronto who has been president since November 1941 will give the Presidential Address.

SCIENTIFIC SESSIONS

The scientific sessions to be held on Tuesday Wednesday and Thursday evenings, will be addressed by eminent surgeons and specialists, recognized as authorities in their fields. Special scientific meetings will be arranged on the same evenings for specialists in ophthalmology and otolaryngology. The newest developments in general and special fields will be presented in a well rounded program for these evening sessions.

Every afternoon from Monday through Thursday panel discussions led by recognized authorities in each field aided by well qualified collaborators, will be held. Similar meetings held during past Congresses have been most successful largely because of the fact that they permit the participation of a large number of surgeons, thus increasing the opportunities to learn from the experiences of others.

Preliminary plans include the holding of a symposium on fractures and other traumas on one afternoon, and a symposium on cancer on another afternoon. There is always wide interest in these special meetings. Plans for several new features have been discussed but cannot be announced until definite decisions have been made in co-operation with the Committee on Arrangements.

FORUMS ON FUNDAMENTAL SURGICAL PROBLEMS

Great interest has already been shown in the plans for reviving the Forums on Fundamental Surgical Problems which were so popular at the Boston meeting. Research activities have been retarded but not stopped during the war period

and the accumulation of the results of five years of work since the last Congress will certainly assure the presentation of intensely interesting material. The plan is to conduct these forums on Tuesday Wednesday Thursday and Friday mornings, and to include in them brief reports of original clinical and experimental observations relating to the broad aspects of surgery and surgical specialties. No prepared discussions are planned but questions and comments will be invited. The enlistment of the interest of young men who are doing original work, through these forums, is one of the most beneficial results of these sessions which are now considered to be an indispensable feature of every Clinical Congress.

MEDICAL MOTION PICTURES

Medical motion picture exhibits will again be an appreciated feature of the Clinical Congress. The latest available pictures showing surgical procedures and related subjects will be shown. The accumulation of such pictures during the war has not been great but nevertheless a surprising number of new films are being received for review by the College and an interesting variety of educational pictures is assured. The schedule will be arranged so as not to conflict with either the clinical program at the hospitals or the scientific sessions. Both sound and silent standard and color films, will be shown all of which have been approved by the Committee on Medical Motion Pictures.

HOSPITAL CONFERENCES

The first formal session of the Clinical Congress will be the opening meeting of the twenty fifth Hospital Standardization Conference. Dr W Edward Gallie of Toronto president of the College, will preside. The hospital conferences will continue on Monday afternoon, with sessions following on Tuesday Wednesday and Thursday mornings, afternoons, and evenings.

Hospital administrators, members of governing boards, heads of the various hospital departments and their personnel nursing groups and many other persons directly or indirectly concerned about hospital progress will be interested in the discussions of current hospital problems. National organizations representing various groups of hospital personnel will co-operate and participate in the meetings, which will include formal sessions, panel discussions round table conferences, and open forums.

ADVANCE REGISTRATION

The hospitals and medical schools of New York City afford accommodation for a large number of

visiting surgeons, but to insure against over crowding attendance at the Congress will be limited to the number that can be comfortably accommodated at the clinics. The limit of attendance will be based on a survey determining the available facilities in the participating hospitals and schools. It is therefore expected that surgeons who wish to attend the Congress will register in advance.

In accordance with a resolution adopted by the Board of Regents fellows of the College whose dues are paid to December 31, 1946 Initiates of the classes of 1942, 1943, 1944, 1945 and 1946 and fellows in military service will not be required to pay a registration fee for the 1946 Clinical Congress. For endorsed junior candidates the fee is \$5.00. Surgeons, not fellows, who attend as invited guests of the College, will pay a registration fee of \$10.00.

For purposes of identification at the registration desk, fellows should present their fellowship cards. Those surgeons who pay the registration fee in advance will receive a formal receipt which they will exchange for a general admission card upon presentation at the registration desk in the Waldorf Astoria Hotel.

HEADQUARTERS AND TECHNICAL EXHIBITION

Headquarters for the Congress will be established at the Waldorf Astoria where there are excellent facilities. The Technical Exhibition will be held on the Third Floor near the Grand Ballroom. Leading manufacturers of surgical instruments and supplies, sutures, dressings, pharmaceuticals, operating room equipment, x ray apparatus, hospital equipment of all kinds, and publishers of medical books will be represented in the exhibition, which will provide visiting surgeons and hospital people opportunities to inspect carefully the newest and best products of all those industries which are helping to improve the service of hospitals and surgeons.

NEW YORK HOTELS AND THEIR RATES

Besides the Waldorf Astoria, there are a number of first class hotels which are conveniently located. In view of the extreme shortage of hotel rooms which is expected still to prevail next September it is urged that reservations be made as

soon as possible. The hotels which are recommended by the Committee appear in the following list

	Minimum Rate with Bath	Single	Double
Allerton House, 143 East 39th Street.		\$2.75	
Allerton House for Women, 130 East 57th Street.		3.00	
Ambassador, Park Avenue & 51st Street.		8.00	
Astor Broadway & 44th Street		3.50	
Barlison (Women), Lexington Ave. & 63rd Street.		3.50	
Barclay 11 East 48th Street		6.00	
Belmont Plaza, Lexington Ave. & 49th Street		4.00	
Beverly Lexington Ave. & 50th Street		5.00	
Billmore, Madison Ave. & 43rd Street.		5.50	
Bristol, 150 West 48th Street		2.50	
Capitol, 51st Street & 8th Avenue		3.00	
Carlisle, Madison Ave. at 46th Street		6.00	
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ABSTRACTS OF CURRENT LITERATURE SURGERY OF THE HEAD AND NECK

EYE

Krans, J., and Briggs, W. A. Intraocular Foreign Bodies. Problems of Localization and Operative Procedure. *Brit J Ophth.*, 1945 29 557

In this article the authors discuss intraocular foreign bodies, the problems of their localization and the operative procedures. They point out that the posterior approach for the extraction of intraocular foreign bodies, except in cases in which the foreign body is situated anterior to the lens, has become more popular since the war principally because new materials of low magnetic properties have been introduced into the manufacture of war instruments and munitions. Moreover metallic alloys of low magnetic properties will also most likely be extended into peacetime industry. They suggest a new method of localization which requires a less complicated and delicate apparatus than that of Sweet, as well as a new method of extraction. The limbal method is simple but it is not suitable for intraocular foreign bodies of low magnetic quality or for nonmagnetic foreign bodies nor does it provide an accurate measurement of the point on the sclera to be incised from a fixed point on the eyeball.

The authors recommend a method which gives the exact position of the foreign body in the eye to be operated on and the exact point to be incised on the sclera (determined by 1 lateral x ray picture and 1 posterior picture). To find the diameter of the posterior picture are taken on the same film eye, 3 lateral exposures are taken on the same film with the eye directed forward, upward, and downward. From the x ray films the following data are obtained: the radius of the eyeball, the distance of the foreign body in front of or behind the equatorial plane, the meridian in which the foreign body lies from the center of the eye and the distance of the foreign body from the center of the eye. The procedure comprises the use of a conjunctival flap, exposure of, and incision into the sclera, surface diathermy with 100 ma for 2 seconds (for coagulation) incision of the choroid and interrupted application of the magnet for about 2 seconds at 2-second intervals for 50 times before discontinuance of the procedure as useless.

A diagram of a pair of forceps for the extraction of intraocular nonmagnetic foreign bodies is presented
JOSHUA ZUCKERMAN M.D.

Von Sallmann, L.: Penetration of Penicillin into the Eye; Further Studies. *Arch Ophth. Chic.*, 1945 34 195.

Previous studies on the penetration of penicillin into the eye after topical and systemic use were carried out with commercial preparations and the concentrations obtained in various parts of the eye were expressed in Oxford units. A comparison of these results and those of the author is not possible since he used relatively crude preparations and titration according to the Oxford method was not done. The Fleming dilution method was used and the concentrations were given in micrograms per cubic centimeter.

Three local methods designed to introduce comparatively high concentrations of the drug in the anterior segment of the eye were tested on rabbits and the results compared. These methods were subconjunctival injection, iontophoresis, and applying cotton packs saturated with a penicillin solution.

A comparison of the results with a solution of commercial sodium penicillin containing 5,000 units per cubic centimeter showed that the highest concentration was obtained in the aqueous by iontophoresis, and in the cornea and the iris with the ciliary body by the prolonged application with cotton packs. The lowest concentration in the aqueous, cornea, and iris with the ciliary body was observed after subconjunctival injection.

Extremely high concentrations were found in the cornea and the iris with the ciliary body after the application with cotton packs saturated with a solution containing 20,000 Oxford units per cubic centimeter. The content in the aqueous was also higher following this method than after any other.

The ocular tissues and aqueous were almost completely free of penicillin 8 hours after iontophoresis with a solution containing 5,000 Oxford units per cubic centimeter and after a solution containing 20,000 Oxford units per cubic centimeter was applied by saturated cotton packs.

I generally traces were found in the lens and iris after typical administration.

Direct illumination on human eyes with normal and with edematous corneas gave more erratic results and much lower values than direct illuminations on rabbit eyes.

LESTER L. MCCOY, MD

Dena F. P.: Tuberculosis of the Choroid with Inclusion of Bone Tissue (Tuberculosis de la corioidea e inclusion de tejido óseo) *Arch. de oftalmología* 1915 3: 207

A child 5 years of age was sent to the author for examination on account of faint vision, photophobia, and redness of the left eye. Direct illumination showed a tumor of the anterior part of the eyeball, involving chiefly the choroid. General examination showed a primary tubercle of the lung, which was active exudative slight in extent but moderately advanced. The Mantoux reaction was positive at 1:1000. Apparently there had been a hematogenous dissemination of tubercle bacilli from the lung to the left eye.

After 6 months of treatment at a tuberculosis hospital the pulmonary condition was greatly improved but an iridocyclitis had developed in the eye and its condition was such that enucleation was considered advisable. The surgical specimen showed a chronic inflammatory process with nodules made up of various types of cells, predominantly epithelioid cells and Kooster's follicles.

There were also fragments of bone in the choroid but there was no apparent reaction around them. There were evidently two independent findings: a primary hematogenous tuberculosis of the choroid and a metaplastic connective tissue in the conjunctival tissue of the choroid. Some of the bone fragments were within the tuberculous tissue and some of them outside of it. It seems probable that the organization of the choroid tissue took place in embryonic life and that the bone tissue created a point of least resistance which favored the localization of the tubercle in there. ARTHUR G. MORRIS, MD

Márquez, M.: The Technique and Clinical Value of Injection of Hypertonic Salt Solution into Tenon's Space in Detachment of the Retina (Técnica y valor clínico de las inyecciones intratentonianas hipertónicas en el desprendimiento de la retina) *Arch. de oftalmología* 1915 3: 207

A case of traumatic detachment of the retina is described in a boy of 13 years who was injured with a shotgun, one of the shots lodging in the external part of the lower conjunctival cul-de-sac and causing great external hemorrhage and pressure on the eyeball. There was detachment of more than half of the lower part of the retina with a small irregular perforation of the macula, through which the red color of the choroid could be seen. Central vision was abolished as well as more than half of the upper and a part of the internal vision.

This case was treated by a preliminary injection of 1 cc of 2 per cent novocain hydrochloride

followed by the injection into Tenon's space of 1 cc of hypertonic salt solution originally 15 per cent but reduced to 12 per cent by the addition of further anesthetic. This proved superior to the 20 and 30 per cent solutions formerly given. Three injections were given. The visual field was restored to about normal and the visual acuity was greatly improved but not restored to normal.

Several other cases presenting successful results are reviewed briefly and a case in which the treatment was not successful, probably because of detachment of the choroid by extensive hemorrhage. Rest in bed and paralysis of the ciliary muscles with atropine are useful supplementary measures.

Detachment without rupture and rupture with detachment are discussed and the importance of studies of the visual field is emphasized. One must state that this method has not been used more extensively because of the fact that injection into Tenon's space has been confused with subconjunctival injections. The subconjunctival space exists only over the superior third of the eyeball and is superficial. However, Tenon's space is deep and surrounds the posterior part of the eyeball. The needle used for the injection is curved with the opening toward the outer side of the needle which is turned to ward the center of the eyeball. The injection is made slowly inferiorly and externally and as far back as Tenon's space as possible.

Many cases are cured by this method, but if it fails it does not interfere with the later use of surgical procedures. ARTHUR G. MORRIS, MD

Klein, B. A.: Syndromes Leading to Enucleation (I) *J. Ophthalmology* 1915 23: 1193

The results of the studies reported in this study show that there are several other equally important or frequent conditions besides chronic suppurative infiltrating iridocyclitis which lead to enucleation or suggestion of sympathetic ophthalmia after trauma.

The eyes selected for this study had in common a chronic low grade painful state of irritation or inflammation. They were classified into 3 groups: (1) those in which the terminal inflammation was continuous with the immediate post-traumatic reaction and (2) those in which a quiescent interval varying from several weeks to years preceded the activated state of inflammation.

Group 1 consisted of (a) chronic mild septic iridocyclitis which was characterized by moderate photophobia, pain and ciliary injection (b) extensive tissue necrosis with marked contraction of the penetrating injury (Clinically the predominant finding was a complete hyphema which remained stationary without any signs of absorption) (c) sympathetic ophthalmia which in half of the cases had no quiescent interval between the injury and the enucleation. Four of the 6 cases showed the fellow eye to be involved at the time of enucleation. These 4 include the 3 eyes with a quiescent interval.

Group 2 consisted of (a) chronic post-traumatic infiltrating iridocyclitis in which the interval be-

SURGERY OF THE HEAD AND NECK

tween the traumatic reaction and the appearance of the corneal precipitates in the injured eye was usually from 8 to 14 days, (b) endogenous iritis. Two of these cases had a tuberculous uveitis which was bilateral. Two other eyes become painful and inflamed suddenly after 7 and 40 years respectively during an attack of influenza, (c) chronic hemophthalmos, illustrated by a case of double perforation of the eye with glass which resulted in profuse intraocular hemorrhage and required enucleation four years later (There was marked photophobia and ciliary injection in the fellow eye), (d) epithelial implants (Secondary glaucoma considered the most frequent complication of epithelial implants was present in only 3 of the 9 cases), (e) rupture of the degenerated lens and (f) extensive retinal dissection and detachment. Six cases showed this condition, in which a mild late iritis required removal.

Seventy seven eyes were enucleated 17 or 22 per cent, presented nonspecific infiltrating iridocyclitis 9 or 26 per cent, chronic septic endophthalmitis 9 or 26 per cent, epithelial implants 8 per cent, chronic hemophthalmos, extensive contusion ne crosis, and late toxic iritis after longstanding retinal detachment 5 per cent, endogenous iridocyclitis 3 per cent some rarer conditions and 8 per cent sympathetic ophthalmia.

LESLIE L. MCCOY M.D

EAR

Lindsay J R Oppenheimer M J Wycis, H T., and Spiegel E. A.: Receptor Apparatus of the Vestibulovascular Reaction Arch. Otol. Chlc. 1945 41 257

The labyrinthine reflexes upon the vegetative nervous system form an essential part of the various types of sickness caused by motion. Information is lacking regarding the receptor apparatus for such reflexes and therefore this study was undertaken.

The observation had been made (Spiegel and Scala) that in cats in which for other reasons bilateral puncture of the round windows had been made, rotation failed to produce a fall in the blood pressure but still was able to produce a fall in the blood pressure. Since the otolithic apparatus might still have been the origin of the vasomotor reaction the present experiments were undertaken to determine the effect of labyrinthine stimulation on the blood pressure after the otoliths had been thrown off the maculae, to abolish the tonic labyrinthine reflexes.

Guinea pigs were centrifuged according to the method of Wittmack to dislodge the otoliths. The animals were tested for postrotatory nystagmus, reflexes on linear acceleration and positional reflexes before and after centrifugation. Centrifugation for 1 minute at 1500 revolutions per minute resulted in the obliteration of the positional reflexes (righting of the head and compensatory eye movements) and the partial or complete loss of reflexes on linear acceleration but in most of the animals the postrotatory nystagmus remained undiminished which indicated active responses from the semicircular canals. How

ever a fall in the blood pressure could still be elicited upon rotation. Histological preparations confirmed the dislodgment of the otoliths from the maculae while in most instances the cupolas could be observed in their normal positions.

The experiments show therefore, that the reflexes on the vasomotor system do not depend alone upon a functioning otolithic apparatus. However, they do not rule out the possibility that the otolithic apparatus may contribute to the vasomotor reaction. The vasomotor response had formerly been shown to persist after abolition of the postrotatory response but to disappear temporarily on the injection of cocaine in alcohol to paralyze the whole labyrinth. Several interpretations are possible from these experiments but it seems not improbable that the labyrinth functions as a whole as a receptor for reflexes on the vasomotor system and that the various receptors can substitute for each other.

JOHN R. LINDSAY M.D

Druza J G: Aural Manifestations of Leucemia Arch. Otol. Chlc. 1945 41 267

An analytic review of the medical records of 148 subjects with leukemia admitted to the Mount Sinai Hospital in New York, New York, over a period of 5 years yielded the following conclusions.

Aural complications of leukemia are more prevalent than is generally believed. They occurred in 25 of the 148 cases reviewed or in 16.8 per cent. Routine examination of the ears including functional tests of the cochlear and vestibular nerves would disclose an even greater incidence in all likelihood. The aural complications include diseases of the external middle, and internal ear and of the adjacent structures. The pathological changes in the ear as elsewhere in the body are comprised chiefly of hemorrhage, cellular (leucemic) infiltration, and inflammation. Pathological changes in the ear may be revealed on histological examination even in cases in which there was no clinical evidence of aural disease at any time during the illness.

Otitic infections are comparatively more severe in the leucemic than in the nonleukemic patient. They do not infrequently show a strong tendency to early invasion of the adjacent structures. The diagnosis of acute mastoiditis in a leucemic subject may paradoxically be made more difficult by the presence of postauricular swelling and sagging of the bony external canal wall since these signs so well recognized as pathognomonic of suppuration in the mastoid bone may under such circumstances also represent leucemic infiltration in the adjacent soft parts.

NOAH D. FABRICANT M.D

Lindsay J R: The Significance of a Positional Nystagmus to Otoneurological Diagnosis. Laryngoscope 1945 55 527

Postural vertigo and its accompanying positional nystagmus is the most common type of vestibular disturbance in diseases of the central nervous system. It occurs less frequently in peripheral ear

diseases. The syndrome can be produced during routine positional tests. In the lesion central and peripheral in type of positional nystagmus may be differentiated. The first type which is regular in direction or changes direction with alteration of the position is found only in diseases involving the central vestibular pathways. The second type with constant direction may occur in either central or peripheral diseases. Attack of vertigo of the pseudo-Ménière type in which auditory disturbances and central neurological signs are absent have been found to exhibit a postural character as a predominant feature.

In a series of more than 30 cases of the pseudo-Ménière type with positional nystagmus at the time of examination the first type was found in all but 1. This would appear to be strong evidence of a central location of the disturbance. It is possible in the basis of a societal study to differentiate several groups in the general pseudo-Ménière group such as hypertension and arteriosclerosis, toxic involvement by drugs, infections and hypotension while a small number remain doubtful as to etiology. Approximately one half of these cases could be included in the hypertensive group on the basis of low blood pressure and evidence of vasomotor insufficiency. (Ann. Otol. Rhinol. Laryng. 64: 1945, 333-35)

Weinstein, L., and Acheron, H. B.: The Treatment of Acute Suppurative Otitis Media. *J. Am. M. Ass.* 1945 139 53

The authors' purpose in undertaking this work reported in this article was to determine the effectiveness of penicillin as a cure in the treatment of suppurative otitis media and as a means of preventing complications when given very early in the course of the disease, to determine the effective dose range and the length of time over which treatment had to be continued to ascertain whether or not there is any correlation between the total amount of the antibiotic substance required to produce good results and the type of organism in which it is responsible for the infection and to study by means of x-ray examinations the effect of this type of treatment on involvement of the mastoid.

It appears that penicillin is a very effective agent in the treatment of acute suppurative otitis media of which gram positive cocci are the cause.

Complications of suppurative otitis media are reduced to a minimum and mastoiditis which is by far the most common of the sequelae following middle ear infection is almost completely eliminated by penicillin therapy.

Fifty cases of acute suppurative otitis media 45 of which occurred as a complication of scarlet fever were treated with varying doses of penicillin intramuscularly. The external auditory canal was free from exudate in 82 per cent of the patients in less than 4-5 days following the institution of therapy. Recurrence of the infection was observed in 16 per cent of the patient and these responded well to treatment with larger doses of penicillin.

There appeared to be some degree of correlation between the total dosage of penicillin required to effect a cure and the type of organism producing the middle ear infection. Infections in which the hemolytic staphylococcus aureus was present alone or in combination with the beta-hemolytic streptococcus seemed to be more resistant to therapy but responded to larger quantities of the antibiotic agent.

Complications of acute suppurative otitis media were reduced to a minimum, and mastoidectomy was infrequently necessary.

Secondary infections with gram negative bacteria were controlled by the local administration of 10 per cent urethane and 1 per cent sulfanilamide aqueous solution.

The following regimen is suggested for the treatment of acute suppurative otitis media: intramuscular administration of 55,000 units of penicillin immediately after the appearance of exudate in the external auditory canal and repetition of the same dose every 3 hours until the aural discharge has been completely absent for 72 hours.

H. B. Acheron, M.D.

Atkinson, M.: Ménière's Syndrome; Consideration of Results of Medical and Surgical Treatment. *Arch. Neur. Psychiat. Chic.*, 1945, 54 107

The author reviews the various medical treatments in popular use for Ménière's syndrome including salt-free diet and dehydration, sodium fluoride plus ammonium chloride, low salt diet and ammonium chloride, high potassium diet, histamine intravenously and nicotinic acid. It is believed that each of these methods of treatment will give some temporary relief of vertigo in from 65 to 95 per cent of cases. The incidence of improvement in deafness and in tinnitus varies from 9 to 36 per cent. Speculating on the cause for the similarity of results obtained with these various medical treatments the theory of a common basic factor which is affected favorably by all of these treatments is suggested. Increased capillary permeability is suggested as such a factor and may be due to one of two causes: anoxia from a diminished blood supply or retention of some form of protein or chemical. On the basis of the favorable action of each of these various medical treatments might be explained. The author has had better experience with nicotine acid and histamine desensitization in appropriate cases than with other treatments.

Surgical treatments for the prevention of attacks of vertigo are also discussed.

Reichmann's operation on the sacculus endolymphatic sac does not sacrifice hearing but has not met with general favor probably because of 25 per cent failures. Removal of foci of infection, while recommended highly by our writer, has failed to give results in the hands of others. Sectioning of the vestibular division of the eighth nerve is criticized because of its failure to relieve the deafness and tinnitus although the latter may sometimes be improved. Operations on the labyrinth consist of two

types those which destroy the labyrinthine function completely and those which destroy only a part of the vestibular function. The former has the undesirable result of destroying hearing and is unsuitable in bilateral cases or those with useful hearing in the affected ear. Experience with the second type of operation is not yet sufficient, but it seems to offer a safer and more logical procedure in that hearing is preserved.

In conclusion the author points out that medical treatment will relieve or control attacks of vertigo in about 80 per cent of cases and will give relief from tinnitus in about 50 per cent. Hearing can be improved in about 20 per cent of cases. Surgical treatment is recommended only as a last resource to abolish attacks of vertigo.

JOHN R. LINDSAY M.D.

Fowler E. P. Early Diagnosis and the Arrest of Otosclerosis (Clinical and Histological Otosclerosis) *Arch. Otol.* Chic., 1945 43 353

Otosclerosis is the name given to a disease of bone which begins in the bony wall of the labyrinthine capsule. It can be diagnosed only by the occurrence of deafness which is due to a limitation of mobility at the annular ligament which impedes the vibration of the stapes. Such signs as a pinkish glow from the promontory, an apparent increase of hearing for bone conducted sounds, a positive Gellé test, immovability of the malleus, a normally patent eustachian tube, scantiness of cerumen hairs and sweat glands in the external canal, and a family history of otosclerosis with no previous history of aural disease all point to a diagnosis of otosclerosis, but all of these signs may be absent in the presence of otosclerosis and all may be present in the absence of otosclerosis.

Available statistics based on histopathological examination (Guild) indicate that 7.55 per cent of white people harbor otosclerosis, but that only about 1 per cent have ankylosis of the stapes. Adequate statistics in the colored population are lacking, but those available indicate a much lower incidence of otosclerosis, possibly 1 per cent. The disease tends to be most active under the age of 20 and least active after the age of 60 years.

The only clinical indication of beginning ankylosis of the stapes is a slight lowering of the hearing acuity for the lower frequencies. In uncomplicated active otosclerosis with ankylosis the loss of hearing progresses inversely with the frequency or pitch of the tone. There is as yet no knowledge as to the etiology. A similar disease of bone has not been found in other parts of the skeleton.

In order to detect early otosclerosis every child should be examined when it enters school and a history of progressive deafness in the family should lead the observer to examine the child more frequently and to institute measures to correct any abnormalities. Attention should be paid to hormone factors and certain vitamins and minerals, especially around the age of puberty. There is no impressive evidence

that the fenestration operation arrests the otosclerotic lesion.

JOHN R. LINDSAY M.D.

Shambaugh G. E. Jr. Fenestration Operation: A Clinical Study of the Permanence of Its Results. *O. Bull. Northwest Univ. Med. School* 1945 19 259.

The history of the fenestration operation is the story of the search for a method of making a labyrinthine fistula that would remain open.

The early operations failed because new bone formation always closed the fistula with loss of hearing improvement in a few weeks or months after operation. It is now possible to create a fistula in the bony labyrinth that will usually remain open. This is due to advances and changes in technique during the past few years and the author's technique employed most recently shifts the position of the fenestra and the application of the skin flap so as to enhance the conduction of sound vibration from the tympanic membrane to the fistula. This has been employed in 173 operations.

Closure of the fistula to sound occurred in 6.57 per cent of 800 consecutive fenestration operations. Analysis of these cases showed that with each improvement in technique the percentage of closure diminished. The majority of the closures occurred within the first year after operation and in only 2 cases did they occur later than two years after operation.

The criticism most frequently levelled against the fenestration operation has been that the hearing results would be transitory because of bony closure of the fistula. This prediction was borne out in part in the early operations done by the original Lempert technique. Successive improvements in technique, however, have successively reduced the percentage of failures due to bony closure. With the technique used by the author during the past 2½ years 77 per cent of the cases permanently maintain a functionally wide open labyrinthine fistula with maximum hearing improvement, while 86 per cent present a significant hearing improvement.

JOHN F. DELPEL M.D.

NOSE AND SINUSES

Lumsden R. B. Otolaryngology in the Army. *J. Laryngol.* Lond., 1945 60 91.

The author reviews his experience in otology during a period of 4½ years in the Middle East.

Otitis externa presented a high incidence in the summer months, particularly among new recruits compared to seasoned troops. Swimming appeared to be an etiological factor, but was not of prime importance. Acute otitis media showed a high incidence during the summer which also was related to swimming, only a few of the patients observed had not been swimming shortly before the onset of infection. Swimming while suffering from a cold appeared to be the most important factor in the onset of both otitis media and acute sinusitis.

The results which followed limited local use of penicillin in the treatment of chronic sinusitis were unconvincing. The author's opinion was that the climate was not beneficial to upper respiratory infections.

During the year of 1911 and early in 1912 31 per cent of patients with acute otitis media required no treatment. During the similar period in 1913 and 1914 87 per cent of patients required operation.

A review of the complication of otitis media showed 3 cases of meningitis with 2 recoveries, 3 cases of lateral sinus thrombosis with 2 recoveries, 4 cases of temporosphenoidal lobe abscesses with 3 recoveries, 5 cases of labyrinthitis with 5 recoveries, and 3 cases of multiple complications all fatal. The incidence of petrositis in the complicated cases particularly in patients with labyrinthitis was high. Atrophic rhinitis seemed to be aggravated by the hot dry climate and all but the mildest cases had to be returned to a temperate climate. Diptheria proved to be a more dangerous disease in the Middle East than in temperate climates. Neuritis was a common complication and frequently extensive.

Approximately 20 per cent of casualties of all types were found to have sustained some acute trauma. Mixed deafness was found in 40 per cent of such cases. In one hospital over 40 per cent of ruptured drums in traumatic cases had a suppurated otitis media. This was attributed probably to unwarranted local interference particularly with the syringe and insufflation of sulfonamide powder. The only local procedure which was advised in such cases was the application of a plug of cotton wool and removal of impacted wax with a scoop when necessary.

JOHN K. LUND, M.D.

MOUTH

Eberius, H.: Cancer of the Lip. A Clinical Study of 778 Cases with Particular Regard to Predisposing Factors and Radium Therapy. *Acta Med. Stockh.*, 1943 45 12.

In his investigation of the Radiumhemmet lip cancer material the particular aims of the author have been (1) to find a practical definition of the term, "lip cancer," (2) to throw light on the significance of the so-called predisposing factors and of the precancerous conditions in the development of lip cancer, (3) to clarify the differential clinical pictures of the lip tumor, (4) to determine the frequency of metastasis, the usual time of its appearance and its relation to the status of the primary tumor, (5) to illuminate certain technical problems of treatment in interstitial irradiation, (6) to evaluate the radiological treatment in relation to the cure results obtained on the basis of calculation, i.e., without the elimination of specific categories of cases, and (7) to discover which factors influence the curability of lip cancer and thereby the prognosis.

The author had at his disposal a series of 807 cases of lip cancer from the years 1910 to 1935. All 778

cases of lip cancer which have been accepted for treatment have been followed up to January 1, 1941 when this investigation was terminated.

In the present study the term "lip cancer" is used exclusively with regard to cancer arising in the epithelium of the red of the lip. In all cases of lip cancer in which treatment is at all possible, the local tumor should be treated radiologically. Rather small, not too deeply growing cancers can advantageously be treated with radium. Larger tumors should be treated with roentgen rays. In cases with operable lymph node metastases the main stress should be laid upon the surgical treatment in connection with which both preoperative and postoperative roentgen or teloradium treatment should be given. Inoperable metastases should be treated with roentgen rays or preferably teloradium interstitial irradiation of remnants of metastases can also be used. Prophylactic roentgen treatment of the lymph node regions is recommended for cases without palpable metastases.

NORM D. FAHRENT, M.D.

PHARYNX

Whitefeather, J. E.: Transitional Epithelial Cell Carcinoma of the Nasopharynx. *Am. J. Surg.* 1945 54 357.

Transitional epithelial cell carcinoma of the nasopharynx is not a rare disease. It never develops too late for successful treatment. The disease affects both males and females of all ages and it is exceedingly malignant in children and young adults.

The most common site of the primary lesion is in or near the fossa of Rosenmüller or in the pharyngeal tonsils. One of the earliest symptoms is referable to obstruction of the eustachian tube. Later symptoms are referable to a polypoid obstruction of the nasopharynx. Invasion of the cranial cavity and metastases to the lymph nodes of the neck. Direct metastases are common.

Radiation therapy is the accepted method of treatment and offers the greatest hope at this time whether it be complete arrest or palliation. Patients who are treated before metastases or intracranial extension occurs can expect the best results.

Sixteen cases of transitional epithelial cell carcinoma of the nasopharynx in patients of from 10 to 58 years of age are reported. Metastases were present in all but 2. Six patients are still living. Of these 3 have the disease and 3 are free of it. None of the latter has survived more than 30 months.

JOHN F. DILLER, M.D.

NECK

Meerna, J. H.: Hyperthymic Epithelial Growth Disease. *Am. J. Surg.* 1945 23 179.

Surveying the several phases or types of Graaf disease one may recognize among others, the following:

- 1 Classic Graves disease, with ophthalmopathy, thyrotoxicosis, and goiter
- 2 Graves disease with thyrotoxicosis but no ophthalmopathy
- 3 Hyperophthalmopathic Graves disease with hyperthyroidism, euthyroidism or hypothyroidism in which the ophthalmic phenomena are the most prominent.

The pathogenesis and etiology of the ophthalmopathy has not yet been definitely established. The available evidence indicates that swelling of the orbital contents is a very important, if not the sole, factor concerned in proptosis of the globes. Weakness of the rectus muscles probably also plays a part and the wide separation of the lids, too, may be a factor. The orbital swelling is believed by many to be due to increase in fat. Although the precise cause of the swelling in the ophthalmopathy of Graves disease has not been established with any degree of certainty it is very evident that the anterior lobe of the pituitary gland has some relation to it.

From the point of view of diagnosis, the problem is not one of distinguishing between etiologically distinct types but of deciding in any given case, whether the ophthalmopathy or the thyrotoxicosis constitutes the greater menace to the patient. The manifestations which render the eye condition disquieting are those reflecting swelling and muscle involvement—bulging of the lids, chemosis of the conjunctiva, limitation of the ocular movements, and diplopia. Limitation of upward movement is the most impressive, and probably the most significant, of the muscle phenomena.

A more difficult diagnostic problem is that of recognizing cases in which the eyes are likely to enter the hyperophthalmopathic phase at a later date, with a view to prophylaxis. Males are more prone to develop the hyperophthalmopathic phase than are females. The early occurrence of subjective ophthalmic symptoms should also suggest the possibility of an impending hyperophthalmopathic course. The early occurrence of chemosis and injection of the conjunctiva and of epiphora is also suggestive of the hyperophthalmopathic type, whereas marked lid retraction phenomena with little or none of the phenomena due primarily to swelling favor the classic type.

The treatment of the hyperophthalmopathic type is specific and symptomatic. Thyroidectomy should be avoided in cases in which the development of a hyperophthalmopathic course is considered likely. Enough cases follow this course postoperatively to justify the belief that the removal of the thyroid plays an important part in initiating it.

The administration of thyroid irradiation of the pituitary gland and administration of substances antagonistic to thyrotropin are among the specific measures used in treatment.

Symptomatic treatment consists of adequate protection of the eyes, depleting measures (on the theory that edema of the orbital tissues may play a part) measures aimed at improving the strength of the

extrinsic muscles and surgical procedures from tarsorrhaphy to enucleation. SAMUEL KAHN, M.D.

DAVIS E. D. D., Lederman M., Harnett W. L., Woodman E. M. and Others. Discussion on the Treatment of Carcinoma of the Larynx. *Proc. R. Soc. M. Lond.*, 1945, 38, 353.

DAVIS reviews laryngofissure for early intrinsic carcinoma of the larynx and compares the results with those in cases treated by radium implantation, radiotherapy or radical laryngectomy. The most suitable cases for laryngofissure excision were those in which the growth was limited to the middle or anterior third of the vocal cord. Extension upward to the ventricular band or into the ventricle was no contraindication to excision, but extension to the subglottic area to the posterior commissure or across to the anterior commissure was regarded as a contraindication to this type of operation. The most successful excisions resulting in cures were those done for epidermoid carcinomas of the Grade 1 Broders type. All the operations were done under endotracheal anesthesia with chloroform and ether. The isthmus of the thyroid was usually divided to facilitate tracheotomy, a procedure no longer considered necessary in every case. When tracheotomy was performed the tube was always removed before the patient left the operating room. Extreme care was always taken to insure against the coming of blood into the larynx. Packing of the larynx with gauze or division of the hyoid bone was considered poor surgery. The alae of the thyroid were not removed, but the tissues about them were freed en bloc. In this series there were no deaths. Two of these cases were formerly treated with telradium but showed recurrences and were then treated by laryngofissure, which resulted in 3 year cures.

COLLIDGE recommended routine biopsy because sessile tuberculosis mimics epithelioma of the larynx. Broders classification from the biopsy specimen if indicative of a Group IV carcinoma would suggest radical operation rather than laryngectomy. After radiation therapy, operative technique may become more difficult and tissue devitalization may result in pharyngostasis or necessitate plastic operations. If radiation therapy fails a radical operation should be done rather than laryngofissure. If general physical debility exists, patients are best treated by radiation therapy which should then be regarded as an alternative method. The technique of burying radium needles in the neck should be abandoned in favor of the telradium beam which can be accurately controlled for dosage and causes minimal or no radionecrosis.

LEDERMAN states that radiation therapy in early cases of intrinsic carcinoma of the larynx can offer the patient as much as surgery and with less risk. Statistics were presented which matched Collidge's report of 70 per cent and 60 per cent 10 year survivals after laryngofissure and laryngectomy.

HARNETT reported a series of 123 cases of cancer of the larynx not yet published. The sex ratio was

113 males to 10 females. The average age of the patients was 62 years. There were 57 patients with early cancer of which 15 were treated by radical surgery and 13 were alive after 4 years. Of the 50 in the latter group treated by palliative methods all were dead. Of the 19 treated by radium 8 survived and of the 13 treated by x-ray 4 were alive. The operative mortality from laryngofibrosis (52 cases) was 8.3 per cent.

WOODMAN believes that the method of opening a window into the larynx and inserting radium needles into the lesion should be defended and not be abandoned. He also noted that x-radiation may be given through the window as a follow-up for recurrences.

LISKI states that the preservation of the patient's life rather than his voice should be considered before surgery is recommended. Cerepi can be better controlled now because of new drugs. Hence the result of radiation therapy will become more striking. After laryngofibrosis radiation therapy should be given to decrease the percentage of recurrences.

NAGEL reports that patients treated with x-ray therapy do not completely avoid damage to their voice as is commonly believed. They also suffer from the prolonged treatment and x-ray reaction. Perichondritis is a complication after irradiation. Laryngofibrosis is superior to radiation therapy if the malignancy is of low grade. Patients treated by the

Finis Harmer method of radium implantation through a window in the larynx made uneventful recoveries and suffered little radiation sickness.

WILSON's results from either radiotherapy or surgery did not equal those reported. Wilson thinks that surgery should never be attempted after extensive radiotherapy. He also believes that there is no reliable method of predetermining the radioactivity of a lesion.

BROWN believes that surgery should be limited to simple carcinoma of the cord. The most important advances in laryngeal surgery consisted of the elimination of tracheotomy by means of intubation and the control of bleeding with the cautery point.

CANNITTIN states that tracheotomy is of great value because it diminishes the muscular activity of the pharynx and larynx and thereby promotes better healing.

DAVIS states that the Harmer Finis operation is superior to other forms of therapy because it enables one to give the proper dosage of radium over the area to be treated whereas telerradium and x-ray produces burning of the skin and other complication in the surrounding tissues.

COLLIER and GILL that the local use of radium causes an irregular radiation effect and the tumor properties are not given an homogeneous dose.

REY, M.D. C. P. Saurony, M.D.

SURGERY OF THE NERVOUS SYSTEM

PERIPHERAL NERVES

Sporling R. G.: *Peripheral Nerve Injuries*. J Am Med Ass 1945 129 1011

In the European theater of operations 15 per cent of all battle injuries to the extremities were complicated by nerve damage. If such injuries are mishandled the patient may be left with a useless, anesthetic limb; therefore it was extremely important to set up a program of treatment for them.

Immediate primary suture of a severed nerve is theoretically desirable, but in practice it is not a good plan because battle injuries are almost invariably associated with contusion of the nerve tissue. The optimum time for end-to-end suture is between the third and the ninth weeks after injury.

It was not always possible to return patients with injury of the peripheral nerves to base hospitals for definitive treatment during the optimum period because these injuries were last on the list of priorities for evacuation among neurosurgical cases. These patients usually reached neurosurgical centers in England two to three weeks after wounding. Meanwhile the wounds had been debrided and delayed wound closure done. Most of the definitive treatment was given in England rather than the United States because the optimum time for repair would have passed before the latter could be reached. However, the patients were usually sent to the United States for convalescence. Many serious wound infections or extensive injuries of the soft tissue requiring plastic repair were sent directly to the United States, by-passing England.

Several points were outlined for the management of peripheral nerve injuries in the Manual of Therapy for the European theater.

1. In every wound of the extremities, damage to the nerve trunks must be considered and motor and sensory tests should be made.

2. Even in the presence of nerve injury the wound should be treated as any other soft tissue wound that is, by debridement and delayed closure.

3. If severed nerve ends are visualized during the debridement, they should be approximated if possible. If the gap is too great to permit this both ends should be anchored to the soft tissue with fine steel or tantalum wire. This is to prevent retraction which sometimes complicates later end-to-end suture. Metal sutures aid in later visualization by means of x rays.

4. Muscles and fascia should be approximated loosely over the exposed nerve trunk. No pack should be used. The wound should be closed later.

5. For transportation splints should be applied whether there is associated bone injury or not.

6. The condition of the nerves at operation and the procedure done should be noted on the emergency medical tag or on the cast.

The following principles of nerve repair were stressed.

Nerve ends should be trimmed until normal tubules are visible. The ends should be approximated by epineural sutures with no tension on the suture line.

Hemostasis must be rigid. The use of a through and through suture (sliding stitch) was optional. The recommended suture material was fine tantalum wire on an atraumatic needle.

A small cuff of tantalum foil was usually placed over the suture line, although at one installation a plasma clot (Tarlov's technique) was used.

Removable splints were used rather than casts for the correction of deformities due to injuries. Extension of the flexed joint was begun at the end of the second week after operation and was completed by the fifth week.

Physiotherapy was applied both before and after operation. Galvanic stimulation of denervated muscles will prevent atrophy and retard fibrosis and, accordingly this measure was used routinely, beginning with 15 brisk contractions daily and progressing to 30 contractions. Massage active and passive motion, and moist and dry heat were also used.

There were 6,245 battle casualties with major nerve injuries hospitalized between D-day and V E day. Of these 46 per cent were operated on overseas. The remainder were evacuated to the United States for definitive surgery usually because the neurosurgical centers abroad were overloaded.

In 47 per cent of the surgical cases the nerve was found intact and neurolysis usually external was done. In the remaining cases the operation consisted of end-to-end suture. The number of insurmountable nerve gaps amounted to 1 per cent, as opposed to the 10 per cent found among the cases in which operation was performed in the United States following the North African campaign. This is important because elective bone shortening to facilitate end-to-end suture is not desirable and most nerve grafts are clinical failures.

Early nerve suture possesses three advantages over delayed suture: (1) mobilization of the proximal and distal nerve segments is more readily achieved; (2) fibrosis in the wound, particularly in the nerve stumps, is minimized; and (3) flexion of the contiguous joints is more easily accomplished.

The time lapse between wounding and neurosurgery varied from 28 days in the period after D-day to 42 days in the period of heavy fighting before V E day. The average for the whole period was 39 days which was longer than the optimum period but well within the upper limit of 90 days.

Primary wound healing occurred in 98 per cent of the cases, and demonstrated the wisdom of delaying neurosurgery for three or four weeks.

results he devised a surgical technique which was subsequently modified by Freeman and Watts in 1942. The latter believe that the correct procedure is the division of the anterior thalamocortical fibers, hoping thereby to disassociate the emotional and intellectual components of morbid thought processes.

The authors then review a series of cases 100 in number and divided into 49 male and 51 female patients whose average age was 36 (their ages ranging from 19 to 53 years). This material included 4 cases of melancholia, 5 of severe obsessional states, 2 epileptics subject to frequent attacks with impulsive outbursts and a general parietic, who having had treatment, developed a chronic hallucinosis. The remaining 88 patients were suffering from schizophrenia, 54 of them being catatonics mostly of the excited hyperkinetic type and 13 schizophrenics of the hebephrenic type who were sullen and withdrawn from reality although with occasional impetuous and violent behavior. Judged by ordinary prognostic standards all of these patients were considered hopeless chronic invalids.

The operative technique as described by Freeman and Watts was used throughout the series. From a technique standpoint the operation was a straightforward procedure with few complications, the mortality in the series being 4 per cent. The importance of expert postoperative management is stressed. The impression of the authors that the best results are achieved in cases showing signs of "mental tension" is supported by this series. In the schizophrenia group periodic catatonics gave the best results. It is concluded that the value of the operation in certain types of emotional illness has been well established.

PAUL MERRILL, M.D.

Frykholm, R.: The Treatment of Bilateral Acoustic Tumors. *Acta chir scand* 1945 91: 451.

The incidence of bilateral acoustic tumors has been a subject of discussion for many years. In 1915 Henschen regarded the ratio of bilateral to unilateral acoustic tumors as being 1 in 10. Cushing in 1917 believed that many cases of unilateral tumors were not reported and that probably the ratio was closer to 1 in 100. In the clinic of Professor Olivecrona, in Stockholm during the period from 1922 to 1943, there were recorded 241 cases of unilateral and 6 cases of bilateral acoustic tumors.

The author discusses the cases of 54 patients with unilateral tumors, who were operated upon in this clinic during the period from 1937 to 1939. Radical enucleation of the tumor with preservation of the facial nerve was the objective, for in intracapsular enucleation the nerve is nearly always spared.

Radical removal of the tumor with preservation of the facial nerve was done in 27 cases with 3 deaths, radical removal without preservation of the facial nerve was done in 14 cases with 3 deaths and intracapsular enucleation was done in 13 cases with 2 deaths.

This vast experience was available in the treatment of 6 patients with bilateral tumor, 3 of whom

had a generalized neurofibromatosis. The cases are carefully recorded and it is apparent that they presented many surgical difficulties for 3 of the patients died within 2 months after operation. Frequently operation in two stages was necessary despite the bilateral approach and in no case was a radical removal accomplished on both sides with preservation of function in the facial nerves. The most satisfactory result was obtained in the second case already reported in which the patient is alive 17 years after bilateral intracapsular enucleation. In 3 cases, the tumor on one side was radically removed the tumor on the other side was not dealt with. Thirteen cases in which surgical treatment was carried out have been collected from the literature.

The syndrome presented in bilateral acoustic tumors is as would be expected except that the condition does not necessarily progress evenly on the two sides. There is tinnitus, nerve deafness, loss of nerve conductivity, absence or diminution of corneal reflexes, and roentgen evidence of dilatation of the internal acoustic meatus. These are followed by cerebellar signs, such as ataxia and nystagmus and finally there is increased intracranial pressure with vomiting and papilledema.

In the surgical treatment of acoustic tumors certain aims and restrictions must be observed.

There should be a bilateral approach and the dura should not be closed unless both tumors are removed with their capsules. Complete enucleation should be attempted only on a deaf ear. Radical removal should not be undertaken if one facial nerve has already been paralyzed. If the patient is completely deaf, both tumors should be radically removed provided the facial nerve on the first side functions; a two-stage operation may be indicated.

ADRIEN VERBRUGGEN, M.D.

MISCELLANEOUS

Alpers, B. J. and Forster, F. M.: Arteriovenous Aneurysm of the Great Cerebral Vein and Arteries of the Circle of Willis. Formation by Junction of the Great Cerebral Vein and the Straight Sinus and of the Choroidal Arteries and Anomalous Branches of the Posterior Cerebral Arteries. *Arch. Neur. Psychiat., Chic.* 1945 54: 181.

The authors report a case of arteriovenous aneurysm involving the great cerebral vein (Galen) and the arteries of the circle of Willis. This patient was an 18 year old male with a history of headaches for 18 years. His neurological study was essentially negative but x rays revealed a calcification in the right parieto occipital region, convolutional indentations of the inner table of the skull and complete destruction of the dorsum sellae and the posterior clinoid processes.

Ventriculograms revealed an internal hydrocephalus with a calcified mass projecting into the posterior horn of the right lateral ventricle.

Cranotomy was performed and the ventricle opened which revealed a mass of tortuous arteries

SURGERY OF THE NERVOUS SYSTEM

roots are cut bilaterally from T_{12} or T_{11} to S_1 . Any local tendon shortening which remains can be cared for by manipulation or tenotomy. With splints the flaccid legs can be stabilized to bear weight and with the addition of crutches the patients can learn to walk. Because the bladder no longer empties except when it reaches its critical amount of filling or when deliberately stimulated the patients can remain dry.

In the first of such operations attempted success was not complete because of difficulty in identifying the proper anterior roots, which were counted from what was thought to be S_1 upward. The patients expired from sepsis arising from the urinary tract or bed sores. This has been eliminated in recent years by the use of tidal drainage with solutions M or G as irrigating fluid which also does away with bladder calculi that otherwise occasionally form.

In dorsolumbar anterior rhizotomy the spinous process of T_{12} is identified. A bilateral laminectomy of T_{11} and T_{12} is done. After the dura is opened, the last teeth of the dentate ligament are identified, since the intraspinal nerve which encloses it and leaves by the next dural opening below is the first lumbar. All anterior roots from T_{11} to S_1 are then sectioned but none below S_1 should even be cut. If the patient is very deformed the laminectomy can be done in the lumbar puncture position. Pentothal sodium or an avertin base is the preferred anesthetic.

Since the operation is permanently destructive it should be limited to those patients who have anatomical cord transection. The requirements for this diagnosis are complete absence of voluntary motor power, complete sensory loss, a predominantly flexor

or flexor adductor contraction in the abdominal muscles and in both legs in response to a noxious stimulus applied to the sole of either foot, and the emptying of the bladder in accompaniment to this stimulus or other less noxious stimuli. Although the presence of an extensor thrust had been thought in the past to predicate neural cord connections above and below the lesions, the author has found that its presence or absence is not necessarily an indication of anatomic cord transection and consequently it has no bearing on whether or not a given patient needs an anterior rhizotomy. Of primary importance is the elimination of infection and the establishment of a good general condition since the lack of a good general condition distorts the neurological status.

Ten such rhizotomies have now been performed by the author with the conversion of spastic paraplegia to the flaccid type in all cases. Twenty-four hour urinary control without catheter or drainage has been attained in all but 2 cases. Bed sores and pressure sores were healed or arrested in all cases before operation. Two patients have developed bowel control so that defecation occurs only once a day at a predetermined hour. Three others are well on their way to attaining this end. In the others sufficient time has not yet elapsed. All but 2 are either walking with splints and crutches or learning to do so.

Other patients have not been operated on because of the inability to control sepsis or hypoproteinemia, or because of inadequate intelligence on the part of the patient or ability to get along fairly well in spite of spasticity.

ROBERT E. GREEN, M.D.

and veins in the region of the glomus. More of the ventricle was incised which exposed a mass of vascular abnormalities lying against the tentorium with the vascular stem of attachment toward the midline.

The patient succumbed 2 days following operation, and necropsy studies were done. These revealed an extensive aneurysm arising from the junction of the great cerebral vein (Galeu) with the straight sinus, and with rather extensive arterial communications. The arterial supplies could be followed into it from both choroidal arteries and direct communication could be traced from these arteries to the posterior cerebral artery on each side. A branch from each posterior cerebral artery could be followed while coursing around the mesencephalon and sending branches into the aneurysm.

Only 2 cases of a similar type of arteriovenous aneurysm have previously been reported and both of these were associated with an internal hydrocephalus, the mechanism of which has not been adequately explained. HOWARD A. BROWN, M.D.

Gantt, W. H., and Marshall, E. K., Jr.: Toxicity of Sulfanilamide on Higher Nervous Activity. *Bull. Johns Hopkins Hosp.* 945 77-104.

The authors found that the oral administration of large doses of sulfanilamide considerably exceeding the therapeutic dose produced a generally depressing action upon the conditional reflexes in dogs. Two dogs with previously well established salivary conditional reflexes and a dog with cerebellar motor conditional reflexes became ataxic when given 0.5 gm. of sulfanilamide per kilogram of body weight. The diminished conditional reflexes returned to normal the day following the experiment and there was no permanent impairment of cortical function. GEORGE FRANK, M.D.

Spiegel, I. J., and Lewin, P.: Tourniquet Paralysis. *J. Am. M. Ass.* 1945 139 432.

The authors believe that paralysis of a peripheral nerve follows the application of a tourniquet for hemostatic purposes more often than would be suggested by review of the literature. The reason for this is that most of the lesions produced by the tourniquet are only transitory.

Three cases of peripheral nerve paralysis presumed to be due to application of a tourniquet are described in detail furthermore in each case the particular nerve involved was surgically explored and visualized. Neuromas were found on the nerve in 2 cases with thinning of the nerve structure below the lesion and in the third case the nerve was found to be embedded in scar tissue. The lesion was so extensive in all of the cases that end-to-end suture could not be accomplished because of the long length of nerve that would have to be sacrificed and it then seemed that the peripheral nerve injury would be permanent. Pathological investigation of the nerve lesion was not feasible for none of the nerve was removed. The time of operation was relatively uncertain but in 2

cases the tourniquet was supposed to have been applied for approximately 1½ hours and in the third case for approximately 35 minutes.

In spite of these lesions the tourniquet is to be considered a very important adjunct in surgical procedure on tendons, nerves, bones and joints.

ADRIEN VERSTEEGHE, M.D.

Munro, D.: The Rehabilitation of Patients Totally Paralyzed Below the Waist, with Special Reference to Making Them Ambulatory and Capable of Earning Their Living. *B. Exptl. Med.* 1945 233 453.

With proper treatment all patients with injury to the spinal cord who are intelligent, co-operative, and have the use of their shoulders, arms, and hands can be made to live a socially useful existence.

Among a series of 243 patients with thoracic, lumbar or sacral cord disease observed at the Boston City Hospital 59 cases were analyzed. They were chosen according to the following criteria: the patient must have lived 90 days after the onset of the disease; he must have been rendered incapable of doing gainful work; and the lesion must have been below the second thoracic level. The present study is concerned only with complete anatomic transection of the cord.

Following recovery from spinal shock, patients with anatomic transection develop a "maximal flexor response to a minimal known stimulus," provided the state of nutrition is good and no major infection is present. This reflex consists of dorsiflexion of the great toe, flexion of the ankle, knee and adduction and flexion of the hip. The flexor and extensor tendon reflexes are both hyperactive; the flexor muscles are hypertonic while the extensors have normal tone. In addition there is contraction of the abdominal muscles, which stimulates the urinary bladder and causes it to empty regardless of the amount it contains. The more leaves the bladder so rapidly that even if an indwelling catheter is in place it escapes around it. Thus, the patients cannot be kept dry as long as the mass reflex remains active and since they are constantly wet, bed sores remain a problem. The bowels also empty at unpredictable intervals so that the patient is always soiled with feces.

However, if the mass reflex and its effects can be counteracted, the patient can be made ambulatory with splints. The bladder and bowels can also be brought under sufficient control so that the patient can be trained to get through the night without getting wet and through the day without getting soiled or having to empty his bladder more than once every three hours.

The mass reflex is best eliminated by the intraspinal division of the anterior spinal roots. This attacks the logical point, the motor side of the reflex arc, and converts the hypertonic spastic paraplegia into a flaccid paraplegia. It also prevents spread of the reflex activity to the abdominal muscles and the bladder and thus controls the latter. All anterior

roots are cut bilaterally from T_{12} or T_{11} to S_1 . Any local tendon shortening which remains can be cured for by manipulation or tenotomy. With splints the flaccid legs can be stabilized to bear weight and with the addition of crutches the patients can learn to walk. Because the bladder no longer empties except when it reaches its critical amount of filling or when deliberately stimulated the patients can remain dry.

In the first of such operations attempted success was not complete because of difficulty in identifying the proper anterior roots which were counted from what was thought to be S_1 upward. The patients expired from sepsis arising from the urinary tract or bed sores. This has been eliminated in recent years by the use of tidal drainage with solutions M or G as irrigating fluid which also does away with bladder calculi that otherwise occasionally form.

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ROBERT E. GREEN, M.D.

SURGERY OF THE THORAX

CHEST WALL AND BREAST

Daland, E. M.: Some Unusual Aspects of Cancer of the Breast. *N. England J. M.* 1945 233 515

From previously collected data the author found that there is a much greater life expectancy in patients with carcinoma of the breast who are operated upon than in those who go untreated. A radical mastectomy is considered much superior to a simple mastectomy. Simple mastectomy is reserved as a palliative measure, but x-ray therapy is considered better than simple mastectomy. X-ray therapy is not tolerated well by elderly patients and this group is treated by simple amputation of the breast if a radical operation is considered too formidable.

Three cases of carcinoma of the breast in patients under 19 years of age are reported, also a recurrence 34 years after radical mastectomy and 2 cases of persistent recurrence of low grade cancer over periods of 14 and 10 years respectively.

EARL O. LATIMER, M.D.

Röden, S.: On Cancer of the Breast, with Special Reference to the Results of Different Methods of Treatment. *Acta radiol. Stockh.* 1944 57 5

The author has exhaustively studied 343 cases of carcinoma of the breast treated between 1911 and 1933. The patients operated upon in 1918 and later have generally been subjected to annual examinations. The material was classified according to Stenlind's group I (SI) small and slowly growing larger tumors not fixed to the surroundings and without microscopic metastases to the axilla, group 2 (SII) tumors with axillary metastases as disclosed by microscopic examination, their size being too limited to be classified in Group 3, group 3 (SIII) large and rapidly growing tumors fixed to the skin and underlying tissue with axillary metastases, also all tumors with metastases in the fossa supraclavicularis and further away. There was a total of 343 cases (SI 145, SII 154, and SIII 44).

Operative treatment was given according to Halsted's technique. Electrosurgery was used in 10 cases only. There was a primary mortality of 5.6 per cent.

X-ray therapy has changed throughout the years and on the whole the dosage has been increased. As a rule, therapy can be confined to two fields. The radiation is arranged tangentially to the wall of the breast to lessen the risk of radiation lesions of the lungs. The treatment includes one preoperative and three postoperative series.

There were 127 patients treated by operation alone, 98 by operation and postoperative roentgen treatment, and 118 had roentgen treatment before and after radical surgery.

Of 59 patients in group SI treated by surgery alone 78 per cent survived 5 years and 55 per cent

survived 10 years. After 10 years death due to other causes was as frequent as death due to cancer. Of 17 patients in group SIII treated by operation alone, all died within 3 years.

Of 38 patients in group SI given postoperative irradiation, 71 per cent survived 5 years and 47.9 per cent survived 10 years. Of 51 in group SII, 15.5 per cent survived 5 years, and 13.3 per cent survived 10 years, and of the 9 in group SIII none survived more than 3 years.

The patients treated by irradiation preoperatively and postoperatively included 48 in group SI, 51 in group SII, and 18 in group SIII. Of the first group 90 per cent survived 5 years and 76.3 per cent survived 7 years, but the figures for 10 years are incomplete. Of those in group SII 36.5 per cent survived 5 years and 27.8 per cent survived 7 years. Of those in group SIII none survived for 5 years. The author reports in all cases whether the patient died of cancer or from other causes.

The location of the tumor in the breast is related to its degree of malignancy as follows: (1) upper lateral quadrant, 51 (34.6%) cases less malignant and 96 (65.4%) more malignant; (2) upper medial quadrant, 35 (33.8%) cases less, and 30 (46.2%) cases more malignant; (3) lower lateral quadrant, 18 (40.8%) cases less and 26 (59.2%) more malignant; and (4) lower medial quadrant, 9 (41.7%) cases less, and 10 (58.3%) more malignant.

Data were available in 139 cases of recurrence: 66 cases had recurrence or regional metastases and 73 cases had distant metastases. The recurrences and regional metastases made their appearance on an average of 16 months after operation, while the distant metastases appeared in an average of 21 months. The patients in the group SI developed recurrences or metastases later than those in group SII as would be expected.

EARL O. LATIMER, M.D.

TRACHEA, LUNGS, AND PLEURA

Conant, J. S., and Dale, G.: Closed Extrapleural Pneumonolysis. *J. Thorac. Surg.* 1945 14 34

Closed intrapleural pneumonolysis established itself as a safe and technically satisfactory procedure. Aside from hemorrhagic effusion and subcutaneous emphysema, the complications vary little from those occurring during the course of pneumothorax therapy in patients without adhesions. The procedure has a very low mortality. There is less information, however, regarding the technical results and complications of extrapleural dissection of short pulmonary attachments and those to which portions of the lung are adherent over a relatively wide area.

The author's report is based on 50 operations in which some degree of extrapleural dissection was performed. They represent all instances in which

SURGERY OF THE THORAX

this procedure was used in 143 consecutive intra pleural pneumonolyses. The attachments in these 50 cases were unsuitable for division by the accepted criteria for intrapleural pneumonolysis and under ordinary circumstances these cases would not have been explored. It was possible to obtain satisfactory collapse in 35 or 70 per cent of them by extrapleural dissection. An extensive or complete separation was achieved in 37 cases. If the number performed for exploratory purposes (13) is omitted the operation succeeded in 31 of 37 cases or in 84 per cent of the cases in which an extensive or complete dissection was possible.

No postoperative fluid was noted in 26 cases. Transient effusion occurred in 15 instances. Twenty operations were followed by temperatures of over 100.4 F which lasted no more than 1 week except in the instances in which bloody effusion and staphylococcus empyema occurred. The latter was probably the result of damage to the lung parenchyma in the extremely firm short band. Closed drainage was necessary.

Considerable postoperative bleeding followed the operation in 3 of the patients who had partial dissection (33 per cent) and in 3 patients in the other section (8 per cent). These percentages suggest the various natures of the attachments. The patients with attachments which after exploration are found to be too dangerous to dissect also appear to be the ones associated with the greater percentage of postoperative hemorrhagic effusion, even though the operation is not persisted in. When extensive or complete dissection is possible postoperative oozing is rather infrequent. Dense attachments are frequently vascular and it is suggested that the normal respiratory tug at the denuded line of attachment when exaggerated by coughing and occasional vomiting has the opportunity of rupturing vessels and loosening the coagulum following cantenization of the bleeding points.

There were 6 cases of empyema 5 of which were tuberculous. All of them developed 4 or more months after the procedure. One case of staphylococcus aureus empyema occurred postoperatively.

As to the technique a new type of sponge carrier and dissector previously described by the authors was used in 45 of the 50 operations. The Coryllos pneumonolysis unit was used in nearly all of the cases.

JOSEPH K. NARAY M.D.
Brantigan O. G.: Resection of the Lung in the Treatment of Pulmonary Tuberculosis. Arch Surg 1945 51: 147

Tuberculosis is a systemic infectious disease caused by a specific micro-organism. It most often involves the lung and is usually bilateral, but unfortunately the major disease area is predominantly unilateral and often nilobar. The application of adequate medical measures supplemented by simple surgical procedures will arrest or cure early pulmonary tuberculosis in most cases. Often in the later stages of the disease irreversible structural

changes occur in the bronchial system and cause the failure of ample therapeutic measures.

Accurate diagnosis is extremely important in recognizing irreversible structural changes in the lungs and bronchial system. The use of tomography, bronchography, determinations of intracavitary pressure, bronchoscopy, bronchospirometry and diagnostic pneumothorax as indicated will lead to the correct diagnosis of pulmonary lesions. Only with an accurate diagnosis can the outcome of surgical treatment be predicted.

Pulmonary resection is the only form of treatment that can be used effectively when pneumothorax or phrenic paralysis with or without pneumoperitoneum does not control basilar disease a cavity against the mediastinal surface in the lower half of the chest, or a cavity in the middle portion of a lung. The isolated tuberculous represents a localized form of pulmonary tuberculosis and it is perhaps the only condition in which all of the diseased tissue can be excised.

Controversy is invited when lobectomy is suggested for the treatment of a tension cavity and of unilateral or unilobar disease in a young person. Real contention and perhaps just criticism are encountered when lobectomy of the upper lobe is elected as the method of treatment instead of thoracoplasty.

The criticism of elective lobectomy of the upper lobe for tuberculous must not be allowed to react generally against pulmonary resection for tuberculous. Good results in the whole field of medical and surgical practice depend primarily on the treatment instituted early in the course of any disease.

Nine cases are reported in which resection of the lung was indicated for the treatment of pulmonary tuberculosis. One case resulted in death. This patient had been subjected to a bilateral pneumothorax and a thoracoplasty in a period of 8 years, before undergoing lobectomy performed a year after the final stage of the thoracoplasty was done. If the failure of the thoracoplasty could have been predicted after the failure of the pneumothorax, pneumectomy could have been performed as a primary type of treatment. In 1 of the cases in which removal of a tuberculous was indicated excellent postoperative recovery occurred. The remaining 7 cases showed that the patients were definitely benefited even though the disease was not cured in every case. In 5 of the 9 cases reported, the patients had endobronchial disease. When tuberculous disease of the bronchial stump occurs, there is always the danger of the formation of fistulas months or years after the operation. Endobronchial disease often responds to the bronchoscopic application of silver nitrate even when an infected lung is distal.

Dissection of the hilar structures, which permits individual ligation of the pulmonary artery and veins and also adequate suture of the bronchus with silk, has greatly reduced the development of bronchial fistulas. The dissection in persons with tuberculous has been uniformly easier than dissection in persons with other pulmonary conditions which re-

quire lobectomy or pneumonectomy. Unfortunately tuberculous disease often is located in the upper portion of the lower lobe which places it at the region of the incomplete fissure. As every effort must be made to avoid cutting into tuberculous tissue, the resection, therefore, must frequently be carried into the remaining healthy lobe. Technically it is often less difficult to do a pneumonectomy.

No drainage is used in cases of pneumonectomy and lobectomy of the upper lobe, since there is no method of immediately obliterating the pleural space. Two grams of sulfanilamide and from 150 to 200 c.c. of chlorazodin (1 to 3,300) in sodium tetradecyl sulfate (1 to 500) are placed in the pleural cavity for bactericidal effect. The same drugs and solutions are placed in the pleural cavity when a lobectomy of the lower lobe is done even though it is drained. If the remaining lobe are freed completely from the parietal pleura the pleural space can be obliterated quickly by the use of a low negative pressure suction apparatus. Obliteration of the pleural space usually will prevent both pyogenic and tuberculous infections. It also offers some assurance against opening of the bronchial stump.

Ether or gas or oxygen and ether (given intra-tracheally) is preferred for the anesthesia. One must try to prevent the aspiration of secretions into the other parts of the lung. After operation the patients are given carbon dioxide inhalations and encouraged to cough and move frequently in order to forestall pulmonary complications. The patients receive 500 c.c. of whole citrated blood 24 hours before operation and from 500 to 1,000 c.c. of blood during the operation. They are placed in an oxygen tent 24 hours postoperatively.

The necessity or desirability of thoracoplasty following pulmonary resection must be considered seriously. Overdistention of the remaining pulmonary tissue might encourage activation of a lesion in a remaining diseased lobe, whereas with thoracoplasty it is well known that collapse of the apical region brings about relaxation throughout the whole chest and favors continued healing of any remaining diseased area. On the other hand, it should be clearly recognized that the best results from lobectomy in tuberculosis will come from treatment of early or minimal lesions. LEX FULLEW, M.D.

Smyth, C. J., and Billingsale, T. H.: The Treatment of Lung Abscesses with Penicillin. *J. Am. M. Ass.* 945, 129, 005

Cases of lung abscesses treated with penicillin previously reported are reviewed and 4 new cases which the authors observed during the past 20 months, are reported.

Thirty-one cases of lung abscesses treated with penicillin had been found in the literature, of which 13 were cured, 8 improved and 10 showed no improvement. A table summarizing these cases and including most of the pertinent data presented in the original report is given.

The 4 patients with lung abscesses who were observed by the authors made satisfactory recovery following the long continued intramuscular administration of penicillin. A summary of these 4 cases is given.

From the authors' experiences and the reports of others, it seems probable that many acute lung abscesses may be cured by this means. In the chronic cases of lung abscesses in which there is adequate drainage through a bronchus, it would appear that recovery may be expected with the use of penicillin alone if it is administered a sufficient length of time. In the cases of chronic lung abscesses which do not communicate with a bronchus to allow free drainage, surgical intervention will probably be required. The authors predict that if lung abscesses are recognized early and treated vigorously with penicillin it can reasonably be expected that the mortality and morbidity from this disease will further decrease.

EUGEN C. ROSENBERG, M.D.

Poppe, J. K.: Limitations of Penicillin in Empyema. *J. Am. M. Ass.* 945, 129, 435.

Penicillin has undoubtedly value in preventing empyema when it is administered in large quantities during the incipient stages before frank pus has formed. This is true especially of postpneumonic pleural effusions of the pneumococcal type. Penicillin is also of value in cases of potential contamination of the pleural space following surgical pulmonary resection and traumatic injuries of the lung.

The period of greatest value, however, appears to be during the incipient stages of the infection, preferably even before a pleural effusion has developed. It is also valuable during the developmental stages of a pleural effusion when the fluid remains thin and clear with relatively few pus cells and a sterile culture. The formation of fluid and positive cultures should decrease rapidly within a few days if the penicillin treatment is to be successful in preventing an empyema. The best results seem to be obtained by a combination of parenteral and intrapleural administration of the penicillin, with emphasis placed on the parenteral route. Intrapleural administration alone has not proved adequate. The use of penicillin to avoid drainage of a collection of thick intrapleural pus appears to represent poor judgment and undue optimism. Admittedly the pus can be rendered permanently sterile in a certain number of cases with tremendous doses of penicillin carried out over a long period of time at great expense to the patient for both the penicillin and hospitalization. The most discouraging part of such treatment is the tendency toward an unsatisfactory result, even after the time, effort, and money have been expended.

A trial of 2 or 3 weeks with daily penicillin dosage of over 100,000 units plus intrapleural injections of penicillin in the presence of a pleural effusion seems sufficient in most of these cases of potential empyema. By the end of this time either the infection should be completely cured or the empyema drained if signs

and symptoms of intrapleural infection persist. More than a week of hospitalization will still be required after the penicillin has been stopped in order to watch for latent empyema of which the symptoms have been masked by the penicillin action. Fifty three per cent of Poppe's cases represent recurrences which developed 1 or 2 weeks after the penicillin was stopped.

Asterile, dry nontoxic empyema cavity following the administration of large quantities of penicillin over long periods of time represents one of the most difficult problems. It simulates the unexpandable lung familiar to those dealing with tuberculous pleural effusions associated with artificial pneumothorax.

The author's experience with penicillin in over 150 carefully evaluated cases of pulmonary infections of all types including empyemas, lung abscesses, and bronchiectasis has shown that penicillin does not alter the surgical principles of treatment in any way. Pus must be drained after it is definitely established and chronically diseased tissue which is irreversibly damaged and replaced by scar tissue must be excised.

Patients who have been cured of their empyema by penicillin should be carefully observed for at least a two weeks period for a possible recurrence. Any toxic or nontoxic turbid pleural effusion containing polymorphonuclear cells following a pyogenic infection treated with penicillin should be surgically drained even though the pus is sterile on culture.

STEPHEN A. ZIEGLER, M.D.

Ovst, G. Indications for Surgery in Penetrating Chest Wounds. *Brit. M. J.* 1945 5: 531

The most important object in the treatment of injuries involving the pleura is early pulmonary re-expansion. By this means pleural infection will be limited and respiratory efficiency restored. The evidence, however, suggests that the prognosis of penetrating wounds is influenced as much by the condition of the lung as by that of the pleura.

Expansion of the lung is slower after penetrating wounds than after nonpenetrating wounds, irrespective of the presence of infection. In both hemothorax and hemopneumothorax, pulmonary re-expansion is less rapid after penetrating wounds. In total cases of pneumothorax the prognosis is good in the case of nonpenetrating injuries but after penetrating wounds the chances of persistent pulmonary collapse are high even in the absence of infection. This is the type of case which most frequently calls for surgical evacuation of the pleural hematoma. In most cases this difference is due to pulmonary injury which is not always recognized and treatment directed to the pleura alone will not always result in re-expansion of the lung. Difficulty in resolution of the hemopneumothorax nearly always means pulmonary injury with bronchopleural fistula.

The prognosis of penetrating wounds, moreover, is worse than that of nonpenetrating injuries because pulmonary re-expansion is slower and pleural infection is more likely. Elimination of the pleural space

is of such significance that it is reasonable to regard early pulmonary re-expansion as even more important than avoidance of infection. The former is a more useful means of promoting the latter and the prognosis of localized basal empyema is much better than that of persistent total hemopneumothorax even if the latter remains sterile.

Pulmonary contusion and laceration on the other hand are important causes of delayed expansion of the lung and are nearly always found in the condition of unresolved hemothorax.

Penetrating wounds of the upper lobe have the worst prognosis and are nearly always present with total or apical unresolved hemothorax. If this persists for more than two weeks surgical evacuation is indicated in all cases except those of basal hemothorax.

The main principles of treatment of penetrating wounds therefore are early elimination of pneumothorax and hemothorax and early surgical débridement of large wounds of the lung and pleura.

STEPHEN A. ZIEGLER, M.D.

HEART AND PERICARDIUM

Trent J. C.: Surgical Therapy on the Patent Ductus Arteriosus. Report of 5 Cases. *Arch. Surg.* 1945 51: 106.

A patent ductus arteriosus is a constant threat to life if allowed to persist. The early diagnosis of uncomplicated patent ductus arteriosus is important, therefore, and can be made in almost 100 per cent of the cases if the following criteria are present: (1) a machinery murmur, (2) thrill in the pulmonary area, (3) enlarged pulmonary artery, (4) enlarged heart, (5) enlarged pulmonary vessels, (6) abnormally increased pulse pressure, (7) stunting of growth, (8) normal sense of cyanosis and clubbing of fingers, (9) normal electrocardiogram, and (10) a history of heart disease from early childhood. Not all these criteria may be present in every case.

The presence of a machinery murmur is listed by most observers as essential for the diagnosis. Although in rare instances the diagnosis may be made without it, such diagnoses remain open to question until proved by autopsy or operation.

Surgical therapy is not applicable in all cases of patent ductus arteriosus. As a rule only in those cases in which the patent ductus is uncomplicated by other serious developmental defects is ligation suitable.

All methods employed to date, short of complete division of the ductus, are attended by a certain number of recurrences. Simple ligation with silk wrapping the ligated duct with cellophane in the hope that the fibrosis thus promoted may cause permanent obliteration of the lumen ligation and division of the ductus, each has its good points and hazards.

Ligation of the duct with cellophane offers the safest and most efficient method of occlusion. Hence prophylactic ligation of the uncomplicated patent

ductus arteriosus by qualified surgeons offers the possibility of a normal life expectancy to many patients who otherwise have little hope of living beyond the age of forty STEPHEN A. ZIMMAN M.D.

ESOPHAGUS AND MEDIASTINUM

McHenry L. C.: Benign Esophageal Strictures. *J Oklahoma M Ass* 945 38 469

Benign esophageal strictures are caused primarily by cicatricial contracture of the esophageal wall as a result of injury and healing processes. These injuries are caused most frequently by corrosive chemicals, at times by foreign bodies, by instrumental trauma, by ulceration from severe infections such as typhoid fever and by peptic ulcer. Household lye, which is composed of 95 per cent sodium hydroxide, is by far the most common causative agent. Small children attempt to drink such solution or find the dry powder and mistake it for sugar. Adults at times ingest these caustic substances by mistaking them for some medicament and at times attempt suicide by purposeful ingestion. First aid measures such as dilute vinegar or lemon juice with large amounts of water must be administered very quickly to limit appreciably the extent of the injury. By the time the doctor sees the patient the damage has already been done. Immediate treatment can then be only palliative and supportive. Under proper care the patient may get along fairly well for from two weeks to two months when swallowing becomes more difficult or even impossible because of secondary closure of the esophageal lumen. The ulcerations may be healing and the closure be caused by fibrosis and contracture. Secondary infection may have caused increased swelling, granulations, and even further extension of the tissue damage. This will of course, eventually result in more extensive fibrosis as healing occurs.

Treatment must be directed first toward preserving the life of the patient, second toward maintaining his general state of health so that he may heal his lesions, third toward maintaining a patent esophageal lumen and last toward restoring this lumen to a size compatible with relatively normal esophageal function.

If the patient is in shock he must be treated generally for shock as in any serious injury. Parenteral fluids are usually necessary to maintain fluid balance and prevent acidosis. If there is definite laryngeal obstruction tracheotomy may be necessary. The use of gentle mechanical suction to remove profuse secretions from the mouth and throat is very helpful. Keeping the mouth clean not only makes the patient more comfortable but helps prevent stagnation of infected mouth secretions. Measures such as penicillin and the sulfonamides to prevent secondary infection are of definite value. If the patient does not begin to swallow liquids within a very few days the performance of a gastrostomy will make possible the maintenance of nutrition.

If the patient can be persuaded to swallow a thread and to let the thread remain in place he will

never develop complete occlusion of his esophagus. Attempts to keep the esophageal lumen open by the use of catheters, Levine tubes, or bougies during the stage of acute ulceration are at times successful, but they are dangerous and add an element of trauma to the pathology already present.

Estimation of the degree of damage to the esophagus and of the extent of healing is made by x-ray study and by esophagoscopy. The latter must be done very cautiously and usually only the most proximal portion of the involved area can be visualized.

Once the ulcerations are healed or nearly healed, the problem of obtaining and maintaining an adequate esophageal lumen must be considered.

Dilatation of the strictured esophagus is obtained by passing bougies through the esophagus in gradually increasing sizes. Eventually almost all can be restored to practical function. Except for very mild injuries a lumen of normal size and flexibility is rarely attained. There are several methods of dilatation commonly used. The most easily used is simple peroral passage of bougies made for use in the esophagus. It is rightly called "blind bougienage" in that the operator cannot see that the bougie is engaged in the lumen of the stricture. There is usually a dilated area above the stricture and this is often sacculated with the small lumen lying on the side wall of the sacculatation. A blindly inserted bougie is apt to impinge on the thin wall of the sacculatation rather than enter the lumen and if an appreciable amount of force is used perforation will result. This method is the least effective and the most dangerous of any under consideration. Peroral passage of bougies through an esophagoscope is used in clinics where facilities and trained personnel are available to perform frequent esophagoscopy. A method used almost entirely in several excellent clinics is the passage of bougies over a string which the patient has swallowed. If sufficient string is swallowed to pass well into the small intestine it may be drawn sufficiently taut so that a bougie passed downward over it will be certain to engage in the lumen of whatever passage is present through the esophagus. The fourth method of dilatation was devised by Gabriel Tucker and is known as retrograde bougienage. It necessitates a large gastrostomy. The patient wears the string continually one end being brought out through the abdominal wall, the other through the nose and the ends tied together.

The authors advocate early gastrostomy when the patient cannot or will not swallow a thread. It allows early feeding of a seriously injured patient and the maintenance of a favorable state of nutrition. Freeing the injured esophagus from the irritation of the necessary passage of food allows earlier healing of the local lesions. Lastly, it enables the surgeon to use the most effective and least dangerous of the methods of dilatation.

The authors have studied the records of 53 patients who have suffered burns of the esophagus.

There were no patients under 1 year of age. Over one-half of the patients were 3 years of age or younger. Gastrostomies were performed upon 38 and 21 were treated by direct bouginage only. Usually the bougie was passed through a laryngoscope or esophagoscope with visualization of the proximal stricture. Frequently, after initial visualization of the stricture, simple blind bouginage was employed. Seventeen patients were treated by retrograde dilatations only. Eleven patients were treated by both methods. Three of the series had no dilatations. Many of the patients are treated over long periods of time, the average for the series being just over forty months. The longest period of treatment was eleven years. Eleven patients, just over 21 per cent of the series, died from various causes while under observation. Eight patients, 15.3 per cent, died of perforation of the esophagus by bougies. Four of these were perforated on the first attempt to get a bougie through their esophagus. The authors believe that at least a portion of this mortality might have been prevented if early gastrostomies had been done and no attempt made to dilate the esophagus until healing of the ulcerations had taken place.

Approximately 75 per cent of the patients are eventually relieved of their obstructive symptoms. They lead normal lives and except that they must be very careful to masticate their food thoroughly get along very well.

JOSEPH K. NARAT, M.D.

Abbott, O. A. Abnormal Esophageal Communications. Their Types, Diagnosis and Therapy.
J. Thorac. Surg. 1945 14 382

Abnormal acquired fistulous communications may occur from the esophagus into the bronchial tree, pleural cavity, mediastinum, pericardium, and more remote tissue spaces. The etiology of such conditions depends upon the same factors which may cause fistulas elsewhere, namely malignant tumors, inflammatory diseases, trauma, and possibly predisposing congenital abnormalities. Carcinoma of the esophagus and bronchial tree, and malignancies of neighboring structures constitute the most frequent mediastinal fistula formation. A fistula may develop in conjunction with an esophageal diverticulum. Such a diverticulum is most likely to be of the traction or acquired type so that the diverticulum itself plays a secondary rôle in the actual etiology. The types of trauma which are found reported include gunshot wounds to the chest, penetration by sharp objects, crushing injury to the chest, penetration by bone fragments and surgical procedures such as bougie dilatation, esophagoscopy and anastomoses.

An esophageal fistula presents a serious hazard to the patient's life but not necessarily a hopeless one. The author's report adds 6 permanent closures to the 15 previously recorded. Two unusual cases of esophageal pericardial fistulas are included in the reports. Another case in which a fistula between the esophagus and the trachea occurred in association with

Hodgkin's disease is described and in this the communication was successfully treated.

The history of choking paroxysms on the ingestion of fluids is the most dramatic and suggestive diagnostic symptom especially when it occurs in relation to fluids rather than solids. The latter may easily slip past a relatively small aperture. Dysphagia is a frequent precursor of the complication. The patient may describe the ability to swallow fluids without discomfort when in certain positions. The diagnostic measure of greatest value consists of x-ray visualization of the fistula, preferably with iodized oil to prevent barium irritation of the lung parenchyma. Considerable difficulty may be encountered in trying to visualize these communications directly with the aid of the esophagoscope but the instillation of methylene blue within the esophageal lumen followed by bronchoscopic examination can be a helpful measure. In cases wherein the fistula empties into the pleural cavity or through this route to the body surface, one should look for the presence of food particles, yeast cells or the appearance of ingested dyes.

The fundamentals of therapy are first, the maintenance of nutrition and, second, appropriate drainage of the fistula. Many fistulas will disappear spontaneously under this management provided the etiology is non-cancerous. Specific local therapy may consist of topical applications or a direct surgical approach. The question of when to resort to usual nasal tube feedings and when to resort to gastrostomy may be a vital one. It would appear that in all instances if a nasal tube nutrition is indicated in all instances if a nasal tube can be passed. From the frequency with which coughing paroxysms may be initiated on each gavage can be passed. From the frequency with which coughing paroxysms may be initiated on each gavage suggested as a preferable procedure in some cases. This is more mandatory when the lesion is low in the esophagus or at an esophagogastric anastomosis.

In view of the successful result noted and 4 others mentioned in the literature, topical application of a strong cauterizing agent should be given a trial in esophagobronchial fistulas not secondary to malignancy. Should all other measures fail and surgery appear to be indicated, then jejunostomy should be instituted along with satisfactory thoracic drainage at the time of repair. In lesions secondary to tuberculosis the outlook is extremely poor. In view of the secondary invading organisms, open drainage appears mandatory and this should be done anteriorly to allow subsequent thoracoplasty measures as a means of fistula closure. Furthermore, in consequence of the chronicity of these lesions, gastrostomy or jejunostomy should be an early consideration.

JOSEPH K. NARAT, M.D.

Boros, E.: Carcinoma of the Esophagus. A Survey of 332 Cases. *Gastroenterology* 1945 5 106

Carcinoma of the esophagus is one of the most common of all malignant diseases. The tumor is invariably primary and is most frequently found in the male perhaps because of the greater use of

alcohol and tobacco. It is a disease of middle age although cases of persons aged 19 as well as 90 have been reported.

Analysis of the types of cells constituting the tumor showed them to be squamous carcinomas (78%) adenocarcinomas, and undifferentiated carcinomas. On gross examination the tumor can be differentiated into scirrhous, medullary and papillary types.

Unfortunately subjective as well as physical evidence of the presence of an esophageal tumor does not become manifest early. The symptoms are obscure until considerable growth has occurred and loss of weight and strength are little manifestations. Obstructive features often bring to light the nature of the silent process. Glands in the neck may be the first signs, and esophagoscopy should be performed when a doubt exists, but unfortunately the results of the examination are not always satisfactory.

The most prominent symptoms in the order of frequency are dysphagia, pain, weight loss, vomiting, hoarseness, bleeding and coughing.

While the outlook for the patient with esophageal carcinoma is practically hopeless, impetus in the direction of surgical management has been forthcoming. Boros summarizes the operative treatment of 7 patients on whom a total extirpation was attempted. The lesions, however, were found to be inoperable. Gastrostomy was performed on another group of 168 patients, whose subjective complaints such as swallowing were relieved, but no prolongation of life was obtained. The mortality was 25 per cent, and it was questionable how much real benefit was obtained from the operation.

Dilatation of the narrowed esophageal lumen has given satisfaction, and its mortality is low. Dilatation with the Plummer dilator accomplishes the desired end of enabling the patient to eat and carries little attendant risk.

Among the 80 patients subjected to intensive radiation therapy in this series only occasional improvement in deglutition was observed. The improvement, however, was not sufficient to warrant the inference that such could be expected with any measure of certainty as a consequence of the treatment. For the most part there was but little gross change, and the tumor mass showed no signs of shrinkage when compared with the esophagoscopy observations made before treatment. On the contrary, congestion and edema became more pronounced. The length of life of the patient after radiation therapy ranged from 1 to 11 months.

In spite of everything so far devised, carcinoma of the esophagus is practically always fatal and the results of surgery have been almost uniformly bad.

STEPHEN A. ZIEGLER, M.D.

Norris, T. St. M.: Through-and-Through Bullet Wounds of the Mediastinum with Recovery. *Lancet* Lond., 1945 249: 464.

Three cases of through and through bullet wounds of the mediastinum are presented from a series of 11

penetrating wounds of the chest. One of the 11 patients died, but not a case of hemothorax became infected. It is interesting to note that all of the cases except 1 were seen within a few hours of injury.

Case 1 presented a through-and-through bullet wound of the chest. Serum was given by intravenous drip. On the seventh day a roentgenogram of the chest showed a right hemothorax and a hemopericardium. Aspiration of the pericardium was performed and only a small quantity of partially clotted blood was obtained. The patient was out of bed on the twelfth day. He was evacuated on the twenty-fifth day. Three weeks after the injury a roentgenogram showed the heart shadow to be normal and the lung fields clear.

Case 2 presented a through-and-through bullet wound of the chest. The patient's general condition was grave. A blood transfusion was given. Examination revealed a right hemothorax. A needle was passed into the right chest on the eleventh day and 30 ounces of sterile fluid blood were aspirated. Fifteen ounces of sterile fluid were aspirated on the fourteenth day. The patient was evacuated on the seventeenth day. Two months after injury it was reported that the patient's right lung had expanded fully.

In case 3 the patient had been wounded 7 days previously. He had hemoptysis and had been given sulfonamides by mouth. He had a through-and-through bullet wound of the chest. There was a large right hemothorax which was aspirated. The cultures were sterile. He was evacuated 16 days following injury and 9 days after admission to the hospital.

These cases were treated conservatively. When intrathoracic hemorrhage occurred the patients were not operated on for at least a week. The patients were not moved during the first 48 hours, being left in bed in the clothes in which they arrived. They were given sufficient morphine to make them comfortable during this period. Fluids were given liberally by mouth. Penicillin was given intramuscularly, 30,000 units every three hours. When operation of a hemothorax was carried out, 40,000 units of penicillin in 20 c.c. of saline solution were injected into the pleural cavity. Only small amounts of intravenous therapy were given.

RICHARD J. BENNETT, J. M.D.

Humphreys, G. H., and Southworth, H.: Aplastic Anemia Terminated by Removal of a Mediastinal Tumor. *Am. J. Med. Sci.*, 1945 150: 501.

With the exception of tumors of aberrant parathyroid tissue and those arising from the thymus there are no known mediastinal tumors which have general effects. Only a few tumors apparently associated with anemia, because they influence either the formation or the destruction of blood, have been reported.

The 58 year old patient in the case reported by the authors had a mediastinal tumor which had been present for a number of years. It had resisted radio-

SURGERY OF THE THORAX

therapy but showed no signs of malignancy. During a considerable period of observation the patient suffered from a profound depression of erythrocyte formation, although leucocytes of bone marrow origin were never deficient in number. The red cells present were never abnormal in size or shape and there was no evidence at any time of chronic blood loss or abnormal erythrocyte destruction. During this period of anemia, reticulocytes were never found on any attempt except twice when isolated ones were seen within 48 hours of large transfusions. All of the usual therapeutic measures to stimulate red cell formation were without effect. The patient was maintained with transfusions of whole blood and saline suspensions of erythrocytes for 22 months. The mediastinal tumor was removed without difficulty and the patient made an uncomplicated recovery.

Following removal of the tumor a sharp reticulocytosis occurred with a resultant restoration of the erythrocyte count to normal, where it remained for a year after operation. During this period the patient acted on one occasion as a donor for a transfusion, following which her reticulocytes responded normally, and her blood count was not conspicuously affected. Ten months after operation she developed an abscess in the thigh which required drainage and healed slowly. A year after operation the patient rather suddenly developed acute ascites and jaundice went into coma and died. Autopsy showed widespread hemochromatosis and no evidence of reappearance of the original tumor. The nature of this tumor remains in doubt, although a thymic origin was suggested.

JOSEPH K. NARAT, M.D.

MISCELLANEOUS

Ammon, P. C., Burbank, B., Brewer L. A. III and Burford T. H.: Immediate Care of the Wound of Thorax. *J. Am. M. Ass.* 1945 139 606.

A national plan has been adopted for the early preoperative care of the severe thoracic casualty which program is applicable to the thoracic injuries and wounds which may be encountered in civil and industrial practice.

Adequate resuscitation is a necessary preparation for surgery or for transportation. Unless hemorrhage or the urgency of other wounds dictates early surgical intervention the majority of serious thoracic casualties will be greatly benefited if they are not rushed to the operating tables, because patients with extensive contusions of the lungs or heart are poor risks and surgery in these patients should be delayed whenever possible.

The methods of resuscitation are: (1) restoration of normal thoracic physiological conditions including the control of pain and the treatment of hemorrhathorax, anoxia, and pressure pneumothorax; (2) fluid replacement and (3) the early prevention of infection. Oxygen should be freely used before cyanosis develops in any patient who is restless or dyspneic

or whose pulse remains elevated. Caution should be observed in the administration of morphine. Improving thoracic dysfunction consists of nerve block for the control of pain, thoracentesis and water trap catheter drainage for intrapleural pathological changes, and mechanical suction (catheter aspiration bronchoscopy) for the removal of excessive bronchial fluids.

EMIL C. ROBERTS, M.D.

Berk, M.: Cardioesophageal Relaxation. *Gastroenterology* 1945 5 290

Cardioesophageal relaxation or incompetency of the cardiac sphincter is an abnormality in which contents from the stomach regurgitate freely and passively into the esophagus and may be looked upon as a direct antithesis of achalasia (cardiospasm). Although it can be recognized by means of x rays, and though in itself is apparently not a clinical entity, it nevertheless assumes importance in its differentiation from other conditions occurring in the terminal esophagus. It frequently gives rise to symptomatology distressing enough to require medical attention.

In patients observed by Robins and Jankelson the lower 1 to 3 inches of the esophagus was found to be dilated. These authors classified the dilatation into the two types tubular and globular according to the degree of reflux, its duration and possibly on the gastric tone or intragastric pressure. They divided their cases into three groups according to the importance of the condition: (1) those with demonstrable gross pathological changes within the gastrointestinal tract, (2) those with pathological changes outside of the gastrointestinal tract, and (3) those with only functional disturbances. The third group was termed pure cases of cardioesophageal relaxation. All of the patients were considered unstable and being classed as psychoneurotic. In general this group was characterized by hypochlorhydria, and the x rays revealed hypertonicity of the stomach with moderate pylorospasm. No reverse peristalsis was seen.

Two theories as to the explanation of the phenomenon of cardioesophageal relaxation may explain the reflux of barium into the esophagus. First there is an increase in intragastric pressure due to hypertonicity or hyperperistalsis with equal pressure on both openings. The weaker or cardiac sphincter will give way with reflux of the gastric contents into the esophagus. When the tension is relieved the liquid reflux will return to the stomach aided by esophageal peristalsis and its own weight. The second theory has to do with a disturbance in balance of the autonomic nervous system.

The author reports the case of a 47 year old male who gave a history of stomach trouble since 1917 and complained of epigastric distress. The patient's complaints consisted of intermittent episodes of fullness after meals, belching, pyrosis, nausea, regurgitation and rare vomiting. He complained of no true abdominal pain. Relief from his symptoms would come principally from belching, regurgitation of

small amounts of liquid food, and the use of alkali seltzer. Most important of all, he found that when he took the upright position and walked around he would nearly always obtain relief. In addition he began to note during the past few years that when he ate solid foods he would frequently have the sensation that they had been obstructed at the region of the lower sternum.

Cholecystograms, gastrointestinal series and fluoroscopic observations revealed no gross pathology to be present. Films taken in the recumbent position presented a globular mass of barium just above the cardia in the region of the lower esophagus. In the supine and Trendelenburg positions a portion of the barium was seen to roll back into the esophagus and extend as high as the upper third of the latter. In addition, barium was observed to pass to and fro within the esophagus, according to the phase of respiration. When the patient was placed upright the meal was seen to flow back into the stomach.

An esophagoscopic examination revealed that the esophagus was dilated and flabby. Without meeting the least resistance the instrument could be propelled forward into the stomach. There was no true hiatal hernia.

A diagnosis of cardioesophageal relaxation was made. An attempt was therefore carried out to stimulate the smooth muscle tone by the use of physostigmine and prostigmine given both orally and parenterally, without any apparent benefit. Additional drugs which proved ineffective, were dilute hydrochloric antacids and belladonna. The regimen which seemed most beneficial was to have the patient eat a light meal several hours before bedtime and remain erect during that time.

The importance of cardioesophageal relaxation is its possible confusion with other more significant lesions occurring about the terminal esophagus. In fluoroscopic examination, particularly in the erect position, the esophagus appears normal in all respects, except possibly for the normal lack of delay at the epicardia. If fluoroscopic examination is negative in the erect position and a globular or tubular shadow of barium is seen just above the stomach on the immediate films in the supine position, cardioesophageal relaxation should be suspected.

LLE PULLER, M.D.

Paine, J. R., and Plankers, A. G. A Review of Patients with Intrathoracic Disease and Injury Treated on the Surgical Service of a United States Army General Hospital in North Africa. *Surgery* 1943, 18, 401.

Of 81 patients admitted to the Chest Division of the Surgical Service of a United States Army General Hospital during the period of its operation in North Africa during the spring, summer, and fall of 1943, 66 were battle casualties. The hospital installations were in Nissen huts and tents. Until the end of the Tunisian Campaign this hospital was the most forward of any of the American general hospitals in North Africa. Even at the busiest periods

however the hospital was not called upon to perform primary surgical treatment to any battle casualty except in a few isolated instances.

The report concerns only those patients with intrathoracic disease or injuries involving the thoracic cavity and there was only 1 death during operation, that of a patient with mediastinal teratoma. The treatment of patients with intrapleural accumulations of blood or bloody fluid was accomplished by repeated thoracentesis. Seventeen patients had been subjected to primary major surgical procedures at more forward hospitals, only 1, however, was treated at this hospital. Twenty-six patients had metallic foreign bodies retained within the chest, but none was operated upon at the hospital. Twenty-five per cent of all patients with intrathoracic wounds or injuries were returned to duty after their stay at the hospital, and one patient with an organized intrapleural hematoma was successfully operated upon with gratifying immediate results.

STEPHEN A. ZIEGLER, M.D.

Harrington, S. W.: The Surgical Treatment of the More Common Type of Diaphragmatic Hernia. *Ann. Surg.* 1945, 22, 546.

In the author's experience with 424 cases of diaphragmatic hernia the most common types which require surgical treatment, in order of frequency are esophageal hiatus hernia, hernia due to trauma, indirect or direct, or to inflammatory necrosis, absence of a portion of the diaphragm, *latus pleuroperitonealis* hernia, and hernia through the foramen of Morgagni.

Each of these various types of diaphragmatic hernia presents different clinical manifestations and requires different methods of surgical treatment. Some of the more important clinical and surgical aspects of these different types are considered in the original article.

The clinical syndrome of diaphragmatic hernia may be divided into two main types. The first occurs in cases in which the stomach is the only abdominal organ involved in the hernia. The symptoms are those of intermittent and usually progressive incarceration and obstruction of the stomach. The most common type of diaphragmatic hernia in which the stomach is the only abdominal viscera involved is through the esophageal hiatus. However, this type of hernia may contain various portions of the omentum, according to the amount of stomach involved in the hernia. Inasmuch as this type is progressive the entire stomach may become involved in the hernia, and the colon may also become incorporated in the hernial sac because of its attachment to the greater curvature of the stomach. More rarely the spleen may become involved because of its attachment to the cardia of the stomach. In the cases in which the colon is involved, there may be additional symptoms of partial or complete intestinal obstruction.

The second type is found in the cases in which multiple abdominal viscera are involved in the

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hernia. The hernia is usually of traumatic origin and is caused by laceration of a normal diaphragm. However it also may be of congenital origin and may result from congenital structural deficiency of the diaphragm. The symptoms are more varied and severe than those in the first type because of the multiple structures involved and they are often more acute in onset. The initial symptoms may be those of acute intestinal or gastric obstruction or severe hemorrhage.

In the treatment of all hernias that have occurred through the left portion of the diaphragm, the author prefers the abdominal approach by means of an oblique left rectus incision starting at the ensiform cartilage and extending to the outer border of the rectus muscle. He believes there is less risk of thoracic complications when this approach is used. It is of particular advantage in cases of esophageal hernia for the herniated stomach is usually confined in a sac in the posterior part of the mediastinum and does not enter the true pleural cavity.

In the repair of hernias through the right portion of the diaphragm the author prefers the thoracic approach because the large, right lobe of the liver makes the abnormal opening in the diaphragm inaccessible from the abdominal approach.

The technical difficulties of adequate exposure of the hernial openings through the left portion of the

diaphragm and the esophageal hiatus are often considerable because of fixation of the left lobe of the liver to the leaf of the diaphragm. The exposure is greatly facilitated by cutting the suspensory ligament and retracting the left lobe of the liver to the right. This can be accomplished when the left lobe is small, by folding it on itself, and when it is large by retracting it forward into the wound. The spleen is often very adherent to the posterior part of the diaphragm and hernial openings, but usually can be separated from these structures by blunt dissection. In some instances the spleen has been so traumatized by the injury and so bound into its abnormal position by adhesions that it cannot be separated from the hernial opening without seriously injuring it. This not uncommonly occurs in the traumatic types of hernia, and occasionally in esophageal hiatus hernia. In cases of this type splenectomy is necessary.

Paralysis of the diaphragm produced by temporary or permanent interruption of the phrenic nerve, is of value as a procedure preliminary to radical operative repair of esophageal hiatus hernias. It is a necessary procedure in the surgical treatment of partial thoracic stomach resulting from a congenitally short esophagus. In some cases in which radical operative repair is contraindicated it may be used as a palliative measure.

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ABDOMINAL WALL AND PERITONEUM

Gatch W. D., and Montgomery W. F.: External Hernias Containing Gangrenous Bowel. *J Am Med Ass* 945:290-736.

A review of the reports on strangulated hernia published since 1913 shows that the results of treating this condition are as poor now as they were then. In fact the death rate is about as high today as it was in the days of preaseptic surgery. The plan of treatment described by the authors briefly consists of three parts:

1. Incision of the hernial sac together with the gangrenous bowel within it.

2. Deflation of the obstructed bowel with a Miller Abbott tube down to the point where it is obstructed at the hernial ring. This restores it to a healthy condition and permits giving the patient liquids and soft foods by mouth, which corrects starvation and dehydration.

3. Laparotomy done after the tube has been down for about a week (through a low paramedian incision): excision of the gangrenous bowel, and intestinal anastomosis; plugging of the femoral ring with omentum stitched to it and treatment of the abdominal wound with sulfathiazole after closure of the peritoneum.

Three case histories are given.

EMIL C. ROSENBERG, M.D.

AIRD I: Acute Nonspecific Mesenteric Lymphadenitis. *Brit Med J* 945: 680

Although often described in British, American and other medical literature the author believes that acute nonspecific mesenteric lymphadenitis has found no general acceptance as one of the commonest causes of acute abdominal pain in children and as an occasional puzzling affection of adults. As a rule the term is omitted from the index and text not only of surgical manuals but even of encyclopedic reference works, and there are hospitals in which all inflammatory enlargements of abdominal lymphatic glands are presumed to be tuberculous. If the condition is mistaken for acute appendicitis as it frequently is, no great harm is done. It may be wise to sacrifice accuracy for safety. Material injustice may be caused however if the disease is wrongly labelled "tuberculosis" the patient's medical record is distorted, relatives are subjected to unnecessary anxiety and the premium for a life insurance policy may be raised.

As to the pathological features, the mesenteric glands—juxtaintestinal along the mesenteric attachment of the lowest few feet of ileum, intermediate along the ileal arteries and terminal on the main superior mesenteric trunk—are discretely enlarged. The first or the last of these groups may be involved alone or all three groups may suffer together. The

anterior and posterior cecal and ileocolic glands or may not be simultaneously affected. The intestinal glands are predominantly involved in early stages of the disease, early in an attack they may be pink in color but usually they are found to be white. The intermediate and terminal glands are predominantly affected in later stages of the disease, they seem always to be white in color. The mesenteric glands are soft and juicy at first, elastic later, and finally quite hard. It is uncertain whether obstruction ever occurs in nontuberculous adenitis. The leaves of the mesentery, and if the terminal superior mesenteric glands are involved the adjacent peritoneum of the posterior abdominal wall, are congested. The peritoneum of the anterior abdominal wall is nearly always unaltered. The ileum, at times the cecum and appendix as well, may show serious hyperemia, and sometimes a patchy edema of the whole thickness of the bowel wall. This inflammatory appearance of the intestine is commonly found only during earlier attacks of the disease. It may affect a considerable length of ileum, or several discrete stretches of bowel, or even one short segment or it may be restricted merely to palpable thickening of Peyer's patches. Frequently with or without an inflammatory appearance of the bowel there is a small quantity of clear fluid in the peritoneal cavity.

The history is not particularly characteristic. In patients more often male than female, in most children beyond the years of infancy but the condition has been recorded at 10 months and at 2 years of age. The pain is essentially a general abdominal colic, often of extreme severity and very intense and alarming than the initial colic of appendicitis in childhood. Between spasms of colic there is entire freedom from pain. Even during the initial attack of pain the patient moves freely about, and violently sometimes, with a constant changing of position which would be unusual in acute appendicitis. As in appendicitis, when the patient is asked to indicate the site of most intense pain, he points to the right lower quadrant. In contrast to the patient with acute obstructive appendicitis, however, he cannot locate the site of maximum pain precisely, but indicates an ill-defined area on the right side. Nausea usually with vomiting, accompanies one at least, of the initial attacks. Diarrhea is exceptional. There has been quite often a recent sore throat or other upper respiratory infection.

Clinical examination provides no more specific evidence than does the history. The patient may seem little affected except by pain, or may be flushed and obviously feverish or pale. He is seldom or never prostrated or ominously motionless. If taken early in an attack, the temperature is elevated to 100° or even substantially higher and on the first day the

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here is an almost invariable leucocytosis of from 5,000 to 20,000 with 80 per cent or more of granular cells. As a rule the white count falls again on the second day—its elevation is quicker, higher and shorter-lived than in acute appendicitis. A bright red pharyngitis is not an unusual concomitant of nonspecific mesenteric adenitis but neither its presence nor its absence is highly significant. On abdominal examination tenderness is elicited in the right iliac fossa, higher and more medial than the usual tenderness of acute appendicitis. The lowest limit of tenderness is just below and to the right of the umbilicus. When the terminal (superior mesenteric) glands are widely involved a band of tenderness may be outlined as it extends upwards and to the left towards, and sometimes just beyond the midline of the epigastrium. The right lower abdominal muscles are nearly always in slightly higher tone than their fellows of the opposite side but rigidity is not maximal or if it is the muscles soften perceptibly under continued gentle pressure. Rebound tenderness is not unusual, particularly if the leaves of the mesentery or the serosa of the bowel are inflamed. One sign, shifting tenderness, is said to be suggestive though its absence is not significant. To elicit shifting tenderness the site of maximum tenderness is located while the patient lies supine, the position is then changed to the left lateral, and after a few minutes, if the sign is present the point of maximum tenderness will be found to have moved leftward to or beyond the midline. The sign depends upon postural displacement of the lower ileum with its mesentery, and is elicited only if the juxtaileal physical glands are inflamed. Rarely it may be positive early in acute appendicitis if the cecum is highly mobile. The enlarged glands are seldom palpable, even those at the root of the mesentery fixed against the background of the posterior abdominal wall and free fluid is not often of sufficient amount to be detected by percussion.

Confusion with appendicitis is less likely to occur in practice than seems possible when the symptoms and signs of the two conditions are compared on paper. The sharp spasms of colic with complete or almost complete freedom from pain between them, the rolling and kicking of the child in an attack, the high and medial situation of the rebound tenderness, the absence (if it is absent) of the rebound tenderness even at the point of shifting tenderness, the presence (if it is present) of shifting tenderness, relaxation under steady pressure of apparently rigid muscles and the history of previous typical recurrent attacks if these have occurred, all inspire confidence in a negative diagnosis of this is not appendicitis even if they fail to suggest the positive diagnosis of nonspecific mesenteric adenitis.

Differentiation of nonspecific from tuberculous mesenteric adenitis is not usually easy. In the latter condition leucocytosis is usually absent throughout the abdominal wall is almost completely lax, the enlarged matted glands are usually palpable and pain

or at least discomfort is more constant between attacks. If operation is not performed and doubt exists, it is not only more accurate but it serves better the interest of patient and of community to regard the condition as nonspecific unless there is clear evidence of tuberculosis elsewhere—in neck or chest, for example.

Other forms of mesenteric gland enlargement seldom produce acute abdominal symptoms. At operation malignant glands can usually be recognized by their character. In lymphadenoma and infectious mononucleosis glands elsewhere in the body are simultaneously enlarged. Even so it is wise in nonspecific adenitis to carry out a differential white count and the Paul Bunnell test.

The appearance in the glands, and more especially the appearances (when they are present) in the wall of the intestine are those of acute inflammation and strongly suggest a response to infection. The appendicular origin of nonspecific adenitis, however, is difficult to substantiate when it is remembered that the juxtaileal glands predominantly and in variously enlarged in the early case of adenitis are not found enlarged at operations for overt appendicular infections.

Nonspecific adenitis has been ascribed to the passage of a hypothetical virus through the mucosa of the intestine to its submucous lymphatic tissue, and thence to the mesenteric glands. Some support is lent to this hypothesis by the failure to culture bacteria from glands which are apparently the seat of acute inflammation. The coincidence or precedence of upper respiratory tract infection is an additional argument in favor of a more or less generalized virus infection. A relationship might be suggested between mesenteric lymphadenitis and the acute regional ileitis of Crohn. The gland enlargement in the mesentery of the affected bowel in regional ileitis is identical with that seen in nonspecific mesenteric adenitis indeed it is a nonspecific mesenteric adenitis. Conversely an early nonspecific mesenteric adenitis accompanied by a patchy pink inflammation of the serous coat of ileum and more significantly still, by an edema of all coats sharply demarcated from healthy bowel suggests an early, mild, self-limiting regional ileitis. It is a regional ileitis in the widest sense of the term. The identity or diversity of the two conditions could be proved only by the demonstration of the ultimate cause of one of them or the causes of both.

In the author's experience appendectomy does not affect the course of the disease which in any case is self-limiting and from which ultimate recovery seems to be inevitable. JOSEPH K. NARAT, M.D.

GASTROINTESTINAL TRACT

Hardt, L. L., Hufford, A. R., and Rabens, J. I. An Analytical Survey of 1,133 Patients Gastroscopically Examined. *Gastroenterology* 1945 4: 477

One or more gastroscopic and roentgenological examinations were performed on 1,132 patients who

cosin. One block was made through the anastomotic junction extending through the ulcer and the other section from the anastomotic ring free of gross ulceration.

In this study the gastrojejunal ulcer was found to be a disease of middle age. 93 per cent of the patients were men and 7 per cent were women. Pain was the most common symptom of gastrojejunal ulcer in this series of patients, being present in 86 per cent of the patients. The location of the pain varied markedly. In some patients the pain was epigastric or the same as that produced by the original duodenal ulcer. In others the pain extended downward to either side of the umbilicus or upward to the shoulder blades. At times the pain extended downward as far as the groin.

Hemorrhage was the most common symptom. Hematemesis and melena occurred in 32 per cent of the patients and melena alone in 42 per cent. The hemorrhages varied from massive single hemorrhages to repeated small hemorrhages. Vomiting occurred in 24 per cent of the cases.

Histological examination in this series showed that 81 per cent of the ulcers were on the jejunal side of the anastomosis, 3 per cent on the gastric side, and 3 per cent on the anastomotic line. The site of the remaining 13 per cent could not be determined.

In general, the ulcers resembled the peptic ulcers customarily seen. They were typically rounded and stamped out the mucosa and submucosa were absent over the base of the ulcer, and the muscular layers were completely replaced by fibrous tissue. Serosa was absent in all instances. It was concluded, however, that the absence of serosa was secondary in importance to the method of preparation of the slide. The anastomotic junction showed that the mucosa was well united in most instances but varied somewhat from the normal. Usually the gastric and jejunal mucosa ended abruptly but there were instances in which the jejunal glands were seen on the gastric side of the anastomosis. In a similar fashion gastric glands with acid cells were seen as frequently on the jejunal side of the anastomosis.

In the majority of cases a moderate degree of both gastritis and jejunitis was noticed. An attempt was made to correlate the severity of the clinical symptoms with the pathological changes, but relationship was evident. In some cases of severe gastrojejunitis only mild symptoms occurred whereas, on the other hand, in some cases of mild gastrojejunitis the clinical symptoms were severe.

SAMUEL J. FOSKLOV, M.D.

Ransom, H. K. Gastrojejunocolic Fistula. *Surg* 1937 945 18 177

During the 10 year period from 1934 to 1944 47 patients were treated by surgical operation for marginal or jejunal ulcer at the University of Michigan Hospital, Ann Arbor. Five of these 47 patients required an additional operation during this same period because of recurrent gastrojejunal ulceration and 1 patient was operated upon three times for

the same condition. Thus, a total of 54 operations was performed upon 47 patients. Of the above mentioned 47 patients, 8 (17%) had the serious complication of gastrojejunocolic fistula. It is with this latter group of cases that the present discussion is concerned.

A survey was made of all of the cases of gastrojejunocolic fistula at the University Hospital since its opening in 1925 and it was found that during 1925 to 1944, 18 unmistakable cases of gastrojejunocolic fistula due to ulcer had been encountered.

Gastrojejunocolic fistula almost invariably occurs as a complication of a marginal or jejunal ulcer at the site of a gastroenteric anastomosis for duodenal ulcer. The great majority of cases occur in instances of posterior gastrojejunostomy and much more often following simple short circuit operations rather than in cases of gastrojejunostomy associated with partial gastric resection. In every one of the 18 cases under discussion, duodenal ulcer was the primary lesion. It is a well accepted fact that marginal ulcer rarely occurs following gastroenterostomy for gastric ulcer and is almost unheard of following gastroenterostomy for carcinoma of the stomach. It is often stated that gastrojejunocolic fistula and gastrojejunal ulcer very rarely occur in women, the reason for this being the lower values for gastric acidity in women as compared with men. While the exact cause of marginal or jejunal ulcer is not known, the prevailing view is that these lesions most often occur in patients whose gastric acidity remains high following operation. This is much more apt to be true in gastroenterostomy or duodenal excision operations as contrasted with subtotal gastrectomy. In all of the authors cases, save 1 posterior gastroenterostomy was the primary operation which was followed later by a marginal ulcer.

It would be expected that prior to the onset of the fistula, symptoms of an anastomotic ulcer would usually be present. This, however, was not true in the majority of the cases herein reported as only 6, or one-third of the 18 patients gave such a history. The remaining 12 patients in this series apparently were relatively symptom free until the onset of the symptoms of fistula. In view of the mechanical nature of the lesion any great improvement in the state of nutrition prior to operation is difficult or impossible. Preoperative laboratory work should include the determination of serum proteins and prothrombin clotting time.

The surgical operation in all cases consisted of a one stage procedure. In 10 instances a restorative type of operation was performed whereas in 4 cases, gastric resection was included. There was 1 post-operative death in each group, or a mortality of 14.3 per cent for the entire series.

Follow up studies showed that all patients who survived operations including gastric resection had good results, whereas only 4 of the 9 patients surviving the more conservative operative procedures remained free of ulcer symptoms. Three of the 5 patients with recurrent ulcer subsequently required

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further surgical therapy. No deaths occurred among these patients who later required reoperation.

While gastric resection is ordinarily desirable at the time of the operation for the repair of the fistulas, it is not always feasible or safe. Restoration of the tract to normal, therefore, is a useful procedure in certain cases. This was true particularly in these cases because many of the original gastroenterostomies were performed upon meager indications as judged by present day standards. If further surgery for recurrence of the ulcer becomes necessary later a subtotal gastrectomy can be carried out upon a patient in good condition with a very low mortality.

Gastrocolic fistulas due to primary disease of the stomach or colon are discussed. The patients present problems in preoperative care and in certain matters of surgical technique which are similar to those just discussed.

A small group of gastroenteric fistulas due to surgical errors at the time of the original operation for ulcer is considered briefly. *JOSEPH GUTER, M.D.*

Berkman, J. M., and Heck, F. J.: Symptoms following Partial Gastric Resection. Gastroenterology 1945 5 85

The authors present a résumé of their observations of the unfavorable symptoms exclusive of recurrent ulceration which may follow partial gastric resection. The cause of these symptoms has not as yet been explained satisfactorily. At the present time however the most commonly accepted explanation of the postprandial symptoms known as the dumping syndrome, is jejunal distention.

The inanition which may occur as a result of the postprandial symptoms may be overcome by placing the patient on a high protein diet, first with a small amount of bulk and then a gradual increase of the bulk to that amount represented by 2500 calories. By this method without further increase of bulk a diet with a caloric value of 3200 calories may be reached which will insure a progressive increase in weight without an increase of the severity of the postprandial symptoms.

A group of patients who have experienced nausea to a sufficient degree to prevent the eating of several nonconsecutive meals each week has been observed. The nausea was not associated with postprandial symptoms and did not follow the taking of food.

Also a number of patients have been seen who although they had experienced no symptoms after partial gastric resection had found it impossible to eat enough in the usual three daily meals to regain the weight lost after operation. By the dietary method described a progressive gain in weight was brought about without postprandial discomfort.

In some cases hypochromic microcytic anemia developed after partial gastric resection and failed to respond to the usual treatment for hypochromic anemia. The value for hemoglobin improved after a high protein diet with a caloric value of 3200 calories had produced an increase in weight.

CHARLES B. ROW, M.D.

Lerner, N. Robinson, H. W., Grishelmer, E. M., and Oppenheimer, M. J.: Effects upon the Small Intestine of Rapid Intravenous Injections of Casein Hydrolysate. Gastroenterology 1945 5 201

The possibility that amino acids when used intravenously may alter intestinal motility and hence endanger new suture lines prompted the authors to study the reaction of the mixture of acids used in the region of pH 5 and may produce a temporary lowering of the blood pH when introduced into the blood stream in sufficient quantities at a rapid rate. The rôle of change in pH on motility is also in need of investigation and the authors study includes such considerations. The duodenum was selected because of the frequency of surgical intervention in this area. Studies were carried out on patients with normal gastrointestinal tracts and on dogs with and without anesthesia.

The authors discuss the methods used and the results obtained in (1) anesthetized dogs (2) patients with normal gastrointestinal tracts and (3) dogs recently operated upon.

In conclusion the authors state that rapid intravenous injections of casein hydrolysate produce a venous hypermotility or change in pattern of duodenal hypermotility or change in pattern of motility in anesthetized dogs. This hypermotility is not accompanied by significant changes in pH of the blood plasma. The blood glucose concentration is elevated. Neither hypermotility nor hyperglycemia is prevented by atropine or vagotomy. New intestinal suture lines are not disturbed by the hypermotility during parenteral use of casein digest. Rapid intravenous injections of casein digest in unanesthetized humans change the character of contractions and often accentuate tonus changes. Subjective sensations and changes in motility were correlated in only half of the cases studied.

EMIL C. ROBINOW, M.D.

Falk, H. C., and Hochman, S.: Intestinal Injury and Fecal Fistula in Gynecological Surgery. Am. J. Surg. 1945 70 176

The small or large intestine may be injured during any gynecological laparotomy, most often on the separation of adhesions found between the intestines, the pelvic viscera and the abdominal wall. These adhesions may be the result of pelvic inflammatory disease or of previous operations. This is shown by the high incidence of fecal fistulas following surgery for pelvic inflammatory disease.

There were 42 cases of intestinal injury observed by the Gynecological Service of the Harlem Hospital from 1928 to 1943 where more than 80 per cent of the patients operated upon have some degree of pelvic inflammatory disease. During this period of 16 years 5055 laparotomies were performed. The known incidence of intestinal injury was therefore 0.83 per cent.

The intestines may be injured on opening the peritoneal cavity. This type of injury as a rule is

detected and repaired immediately. Such accidents are more common in patients who have had a previous laparotomy. In this series there was only 1 such case. No fistula followed. The bowel may also be lacerated in cutting across the vagina in a total hysterectomy if the rectum is adherent to the posterior wall of the cervix. There was no such accident in this series. Injury to the intestines may also occur in the separation of adhesions between two loops of bowel, the intestines and pelvic organs, or between the intestines and the abdominal wall.

Two types of adhesions are found: those caused by a previous laparotomy in which the intestines and omentum may be firmly matted together with the pelvic organs, and those caused by pelvic inflammatory disease, gonorrhea produces few adhesions except at the fimbriated end of the tube. The adhesions between the intestines and the tubal wall are usually friable, thin and flimsy and easily separated. When the pus has spilled into the cul-de-sac, the adhesions between the sigmoid tube, and posterior wall of the broad ligament are very dense. Here the separation is usually done blindly (without vision) and the large bowel may easily be injured; such an injury may not be recognized. There were 7 such cases of injury in which the sigmoid was densely adherent to a tubo-ovarian abscess or pyosalpinx.

Usually the intestinal injury is seen and recognized at the time of operation. There were, however, many cases in which the intestinal trauma ultimately caused necrosis of the bowel, but no injury had been recognized at the time of operation. As a result, a fecal fistula or fatal peritonitis occurred post-operatively.

In pelvic inflammatory disease of pyogenic or tuberculous origin, degenerated or infected fibroids, endometriosis, ovarian and tubo-ovarian abscesses and malignancies the adhesions encountered are very dense. In the separation of these adhesions to isolate the pelvic structures, the intestines are easily injured.

The most reliable index of acuteness of pelvic inflammatory disease is the sedimentation rate.

Among the 18 cases of fecal fistula, there were only 4 in which the sedimentation rate was longer than 30 minutes.

The 42 cases of intestinal injury were divided as follows:

1. Injury detected and repaired during operation without fecal fistula formation—22 cases.

2. Injury detected and repaired at operation, with the development of fecal fistula—3 cases.

3. Injury not detected at operation, with result ing fecal fistula—15 cases.

4. Injury not detected at operation, with result ing peritonitis and death—2 cases.

1 and 2. Injury detected and repaired during operation—25 cases. In 25 or 59.5 per cent, of the total number of 42 cases, injury to the intestines was detected and repair was accomplished during operation.

The prognosis in intestinal injury is largely dependent upon recognition and repair at time of operation.

Repair of intestinal injuries was accomplished by two to three rows of locked, interrupted, or continuous running sutures of No. 00 chromic catgut or Pagenstecher thread.

In recent years 10 gm. of a sulfonamide were placed into the pelvis and over the repaired area.

The treatment of fecal fistulas low in the intestinal tract, as in the terminal ileum, sigmoid, or rectum, is much less urgent than that of those located in the duodenum or upper jejunum because of the slight loss of fluids, food and enzymes. Fistulas of the large bowel or terminal ileum usually heal spontaneously. Sufficient time should be allowed for the fistulas to close spontaneously before surgery is attempted.

HARRY W. FINE, M.D.

Pugh, H. L.: Regional Enteritis. *Ann. Surg.* 1945, 121: 845.

Crohn, Ginsburg, and Oppenheimer in 1933 published the original article describing the clinical entity known as regional enteritis. This article was so accurate that all the literature contributing to the subject in the past 13 years has subtracted nothing from it. The original title was "Terminal Ileitis." The author has substituted the word "regional," since "terminal suggested agonal and enteritis has been substituted for "ileitis" since not infrequently other parts of the small or large bowel have been affected. Numerous names have been suggested for this condition, among which have been terminal ileitis, regional ileitis, regional ileocolitis, regional enterocolitis, segmental enteritis, nonspecific granuloma, infective granuloma, chronic cicatrizing enteritis, pseudocancer, Crohn's disease, and regional enteritis. The last mentioned term is the most popular and comes nearest to being true and appropriate.

The authors present a series of 17 cases, and furnish some of the special observations which have been made by a variety of contributors.

It is believed that this disease has existed for centuries. W. J. Mayo in 1893, Combe in 1913, and Moschowitz in 1923 described cases in the literature which probably were regional enteritis. There appears to be a definite increase in the incidence of the disease which cannot be entirely explained by the improvement in diagnosis.

The etiology of this condition is still unknown. The theory that Koch's bacillus may be the causative agent has been disproved. It is not improbable that there may be some correlation with mesenteric lymphadenitis. An allergic tie-up is still fanciful. Several writers have reported that the malady has a predilection for Jews, particularly at an early age.

It has been claimed that the disease is more prevalent in Eastern cities, and it is probable that there may be a seasonal variation in the tendency to acute exacerbation of the disease. Crohn suggested the disease may have a familial tendency. The disease is more likely to appear between the ages of

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15 and 40 and the majority of statistical reports indicate a slightly greater frequency in males than females.

Knowledge of the early stage of regional enteritis remains conjectural, since it is seldom recognized until thoroughly advanced. It probably begins as a proliferative process in the interstitial structure of the bowel wall and progresses to a cicatrizing granularomatous lesion. The mucosa becomes ulcerated as the bowel thickens possibly from interference with the blood supply, or from an infective process (virus or bacterial). Fibrosis develops and the bowel wall thickens. This, plus the contraction of cicatrizing thickens, narrows the lumen until obstruction may ensue. The adjacent mesentery becomes thickened and discrete. Both the bowel and the mesentery become edematous. With progress of the disease the ulcerated areas may perforate and lead to abscess and fistula formation. These fistulas may communicate with loops of small bowel, large bowel, bladder, or even through the abdominal wall. Some writers believe that the disease passes through four stages, namely (1) acute, (2) irritative (3) obstructive, and (4) fistulous.

Almost any part of the intestinal tract from the jejunum to the sigmoid may be involved, with the terminal ileum the favorite site. The disease not infrequently extends past the ileocecal junction and invades the cecum. Skip areas in several portions of the bowel in the same person may be involved with healthy segments intervening.

The disease is chronic and is characterized by periods of exacerbation and remission. The weight of evidence and opinion indicates that spontaneous cure, if it ever occurs, is rare.

The involved bowel during acute stages of the disease is swollen, hyperemic, and inflamed. The mesentery is swollen, edematous, and likewise inflamed with lymph nodes varying in size from that of a pea to a walnut. Gross corrugations extend from the mesenteric border and tend to encircle the bowel and give it a cobblestone appearance. It is not uncommon to see a considerable accumulation of serosanguineous fluid within the peritoneal cavity during the acute phase. The involved bowel by contrast during the quiescent or remission stage, remains heavy, thickened and leathery—devoid of its normal flexibility and distendability. As the hyperemia subsides the plastic exudate organizes and forms dense fibrous bands and adhesions.

Histologically the affected bowel reveals a marked fibrosis and thickening of mucosal and submucosal layers. The entire structure of the bowel wall shows a mononuclear infiltration. Giant cells are not uncommon and frequently lead to a false diagnosis of tuberculosis.

The symptoms depend on the stage, location and severity of the disease. The three cardinal symptoms are intermittent cramplike abdominal pain, intermittent diarrhea and loss of weight. Nausea is not uncommon and when present is usually accompa-

nied by diarrhea. Anorexia is frequently seen. As the pain is usually in the lower right quadrant it is not surprising that 50 per cent of the cases have been diagnosed as acute appendicitis and operated on for that. Hemorrhage from the bowel occasionally occurs.

Anemia is a common sign of regional enteritis and some temperature elevation particularly with acute exacerbations is common. The temperature may be normal during remissions or may show a slight rise in the afternoon. The white blood count may be elevated to 20,000 in the acute phase or may fluctuate between normal and that commonly associated with acute appendicitis. The blood sedimentation rate is usually elevated. A mass with tender dominal examination a boggy mass may be palpated in the right lower quadrant. A mass with tenderness is sometimes palpated on rectal examination. X ray examination is frequently referred to as the most important diagnostic sign. Intestinal fistulas or the narrowing of the luminal shadow in the terminal ileum (Kantor's string sign) may be demonstrated. When present, this sign is practically pathognomonic of regional enteritis.

The author considers the points mentioned important in differentiating regional enteritis from acute appendicitis, intestinal tuberculosis, amebiasis, diverticulitis, and chronic ulcerative colitis.

In the author's series of cases the following complications occurred in order of their frequency: (1) involvement of segments of the large bowel apparently as direct extension from involved small bowel segment (6 cases) (2) positive Kantor's sign (3) fistulization (6 cases) (4) fistulous communication with abdominal wall—external fistulae (4 cases) (5) the abdominal wall—external fistulae (4 cases) (6) skipped areas in the small bowel (3 cases) (7) apparent subsidence of symptoms and absence of roentgenological signs without operative interference (3 cases) (8) hemorrhage (1 case) (9) recurrence after operation (1 case) (10) fistulae or fissure in ano (1 case).

Of the 3 cases which cleared up without definitive surgery the first at operation showed six areas in the jejunum and ileum typical of regional enteritis with healthy bowel from 1 to 3 feet in length between the diseased segments. Because of the extent and distribution, the patient's abdomen was closed without resecting any bowel. Postoperatively penicillin was given with a rapid improvement in symptoms and negative x ray of the bowel. The second case was diagnosed as regional enteritis after the patient had been operated on for acute appendicitis by another surgeon. Six months later at celiotomy scarcely any evidence of the former acute process was found. The third case was a similar condition which improved so much clinically that a second operation was not considered warranted.

Penicillin was used in 5 cases, all of which showed prompt clinical improvement. While it may be speculative it is believed the drug was a definite factor in the amelioration of symptoms.

The literature preponderantly favors surgery as the treatment of necessity. Elliott Cutler of Harvard University still believes the disease should be treated medically unless certain complications arise. The author believes that surgical treatment is by all odds preferable. All seem to agree that in the acute form of the disease no surgery should be instituted unless some complication such as obstruction makes emergency intervention imperative. It is inadvisable to remove a normal appendix in the presence of enteritis lest a fistula develop. If obstruction is present, most surgeons agree that a short-circuiting operation such as an ileotransverse colostomy should be done. If the operation may be classed as elective, the surgical proponents may be classed in two groups—those who advocate a 2 stage procedure and those who advocate a 1 stage procedure. The author resected the lesion and did an ileotransverse colostomy in 1 stage in all but 2 cases, in 1 of which a 2 stage and in the other a 3 stage procedure was carried out.

There was 1 death in the series. A resection of the right colon was done with an end-to-side ileotransverse colostomy. The patient died 4 days later of urinary suppression, the cause of which was undetermined, but attributed to sulfa drug sensitivity. At autopsy there was no blockage of the uriniferous tubules or peritonitis. ROBERT R. BIGGLOW, M.D.

Centeno, A. M.: Diverticula of the Duodenum (*Diverticulos del duodeno*). *Praxis med. argent.* 945 32 1829.

The clinical and roentgen pictures of ulcer of the duodenum are very well known but those of other diseases of the duodenum are not so well known. As a contribution to this subject the author discusses 55 cases of diverticulum of the duodenum seen at the National Dispensary for Diseases of the Intestinal Tract in Buenos Aires. Roentgenograms of a number of the cases are given.

The first case of diverticulum of the duodenum was described by Chomel in 1710. The first stage in the history of the disease was devoted to autopsy descriptions, the second to roentgen examination and the third to clinical study. Case described the first roentgen examination of the condition in 1903 and Forsell and Kay performed the first surgical operation for its treatment in 1915. Including the 55 cases discussed in this article the total number of cases seen in Argentina has been 158.

These diverticula are most frequent in the second portion of the duodenum, then in the third portion and then in the fourth portion—they are rare in the first portion. Those in the second portion are apt to press on Wirsung's duct and the common bile duct, and cause icterus and the symptoms of pancreatitis. Those of other portions of the duodenum often do not cause any symptoms at all and may be found only on autopsy. Among the author's 55 cases 36 were in the second portion. In only 1 of the cases was the duodenal diverticulum associated with diverticulosis of the colon. These diverticula are

generally solitary. In only 2 of these cases was there a double diverticulum.

These diverticula may be congenital or acquired. In the congenital cases all the layers of the intestinal wall are involved but in the acquired cases the mucosa and submucosa herniate through the muscle layer. The diverticula generally occur in the middle period of life and are about twice as frequent in males as in females. They are frequently complicated by other pathological conditions, and it has been claimed that any uncomplicated diverticulum of the duodenum is symptomless. Of the author's 55 cases, 23 or 41.8 per cent were associated with other diseases: 7 with cystitis, 9 with ulcer of the duodenum, 3 with cancer of the stomach, 2 with ulcer of the stomach, 1 with diverticulosis of the colon, and 1 with diaphragmatic hernia.

The symptoms such as pain and vomiting, are not pathognomonic and roentgen examination is required for definite diagnosis. Icterus may be caused by infection but is not frequent as this part of the intestine does not become infected easily.

Uncomplicated cases should be given medical treatment designed to evacuate the diverticulum and prevent dilatation and infection. This may be accomplished by frequent change of position, the administration of antispasmodics and irrigation of the stomach. Small doses of sodium sulfate or magnesium chloride stimulate the duodenal motility and aid in evacuation. Ten gram doses of bismuth carbonate, kaolin, or magnesium trisilicate may be given for inflammation. If surgery is necessary it consists of invagination or resection. If there is icterus without calculus medical drainage of the bile ducts is preferable.

AUSTIN G. MORRIS, M.D.

Iludinarah, T. A., Stewart, A. W. and Morrison, B.: Resection Operation for Gangrenous Intussusception in Infants. *Brit. M. J.* 1915, 1: 38.

When in an infant an acute intussusception becomes irreducible and gangrenous, not only is the choice of a suitable operation difficult but the results are usually bad. The operation commonly chosen in these cases is either resection of the gangrenous mass with end-to-end or lateral anastomosis, or enterolization of the mass with the formation of an enterostomy with a later attempt to close this if the child survives. Suture of the proximal part of the intussusception to the intussusceptum has also been suggested, the gangrenous mass sloughing and passing per rectum. These operations are far from satisfactory—very few children survive.

In view of these results the authors have recently chosen to treat the irreducible gangrenous intussusception by a rod fixation of the Mikulicz type of resection and are able to report a success. The danger of generalizing from a case is recognized, but the results in these 2 cases were so much better than those experienced with other methods that this report seems justified. At this point, however,

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it should be made clear that no major operation of this sort to an infant will be successful unless the child is given special preoperative and postoperative treatment by those who are experienced in modern pediatric methods and can judge from hour to hour what measures are required to be taken. A note by Brenda Morrison on these measures is included in this article.

The Mikulicz type of resection recommended is made possible in infants because at that age the cecum, ascending colon and transverse colon are very mobile. In both cases it was found easy after a small incision of the peritoneum on the outer side of the intussusception to mobilize the mass and to bring it out of the abdomen with very slight trauma. The next steps of the operation could then be performed expeditiously and with relative ease.

The operative procedure followed in both cases was similar. The preliminary attempt at ordinary methods of reduction having failed the intussusception was found to be gangrenous and some form of resection was therefore necessary. The viable portions of the ileum and colon were quickly joined together in the usual double barrelled Mikulicz colostomy method, by two layers of continuous catgut sutures, and the abdominal incision was closed around the bowel by interrupted sutures. The condition of both cases at the end of operation was satisfactory. After 6 days the spurs were crushed and removed by the ordinary Mikulicz method with the small crushing clamps. Six days later on the twelfth day after operation the stomata were closed after the bowel ends had been freed and turned in.

The first patient has now made an excellent and permanent recovery. The patient has gained satisfactory weight, and a slight tendency to diarrhea, due to loss of the ileocecal junction has cleared up. The second patient made an excellent recovery after operation, and it is anticipated that this patient also will return to normal health.

JOHN E. KIRKPATRICK, M.D.

Newton F. C. and Blodgett J. B. Succinylsulfa-
thiazole and Intestinal Suction in Surgery of
the Large Bowel. *Surgery* 1945 18: 300

There have been two recent important improvements in the operative preparation of patients for surgery of the large bowel. The first is the use of the Miller Abbott tube and the second is the use of chemotherapy to minimize the number and virulence of organisms within the lumen of the bowel. This article is a statistical report of the authors' experience at the Peter Bent Brigham Hospital, Boston, with these two adjuncts to colon surgery. It compares the results in a series of consecutive cases of resection of the large bowel prepared by these two techniques with a series in which they were not used.

Until recently proximal colostomy has been widely used in preparing patients for resection of the large bowel. The advantage of preliminary colostomy is that, preoperatively the bowel is relieved of distention and may regain its function and the

distal lumen may be nearly emptied of its contents and postoperatively the site of anastomosis is kept at rest and the risk of blowout at the suture line from increased intraluminal pressure due to temporary obstruction at the anastomosis is minimized.

A series of 114 cases of resection of the large bowel was studied. The general preoperative and postoperative care was the same in all except that in the test group (36 cases) succinylsulfa-thiazole was used before the operation and postoperative intestinal suction were carried out. In the control group (78 cases) primary colostomy without chemotherapy was the routine in resections with restoration of the continuity.

The Mikulicz type of resection was not required in any cases of the test group.

The following data are of statistical significance in the comparison of the two groups.

1. The gross incidence of complications was reduced from 58 to 45 per cent.
2. The gross mortality was reduced from 19 to 3 per cent.

3. When similar operative procedures (resections and anastomoses) are compared it is found that the incidence of postoperative infection is reduced from 43 to 6 per cent and the mortality is reduced from 22 to 3 per cent.

The use of intestinal suction and succinylsulfa-thiazole in the preoperative and postoperative care of patients who undergo resection of the large bowel has a definite effect in reducing the incidence of postoperative infection and mortality.

JOSEPH GASTER, M.D.

LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

Mirizzi P. L.: Fourteen Years of Experience with
Operative Cholangiography (Colangiografía
operatoria catorce años de experiencia). *Prensa Médica*
Buenos Aires 1945 32: 1887

The first cholangiography practiced during operation was performed June 18, 1931 on a patient with calculous hydrops of the gall bladder. The author reviews his experience with the method in the 14 years since that time illustrating his findings with case histories and cholangiograms.

The method has demonstrated that there is peristalsis of the common duct and that the hepatic duct contracts totally or partially both important factors in the filling and emptying of the gall bladder.

In addition to contributing to our knowledge of the physiology of the bile tract, cholangiography is extremely useful in the diagnosis of many pathological conditions of this tract and has contributed greatly to better the surgical technique in operations on it. It gives the surgeon a so much clearer picture of the tract that he can avoid complications that were formerly frequent such as anatomical disturbances, residual lithiasis, cicatricial stricture of the hepatocommon duct and anomalies.

The important thing now is to help to generalize the use of the method rather than to discuss its value which has been proved beyond doubt.

AUDREY G. MORGAN, M.D.

Cole, W. H., Irenius, C., Jr. and Reynolds, J. T.:
The Use of Vitallium Tubes in Strictures and
Absence of the Common Bile Duct. *A. Surg.*
1945 122 490

The most serious stricture of the common bile duct and the one most difficult to correct is total "absence" of the common duct which unfortunately is more common than the short stricture with sufficient proximal and distal ends for approximation. In 10 of this series of 23 cases of stricture or absence (including a carcinoma of the common hepatic duct) no duct could be found except the stump at the hilus of the liver. In this group the use of the vitallium tube was adopted and a few principles were established which helped the authors to arrive at a method of treating this defect which yielded fairly good results.

The method of repair of stricture depends upon the type of defect encountered. Defects can be divided into four major groups from the standpoint of the technique indicated: (1) local stricture of the common duct, (2) stricture or absence of the terminal end of the common duct, (3) absence or stricture of the common hepatic duct, and (4) absence of the common and common hepatic ducts. In general, the utilization of rubber tubes in repair has not given satisfactory results largely because they are usually passed within a short time. If they are retained there is a slightly greater tendency for the precipitation of bile salts in the lumen than in the lumen of vitallium tubes.

All (15) of the rubber tubes which the authors have inserted have been passed. Of 14 vitallium tubes which they have inserted 3 have been passed. Although the discussion in this presentation is related to the use of vitallium tubes in strictures or absence of the common duct, it is emphasized that whenever possible anastomosis should be made with no more than temporary intraluminal support. The bridging of defects by the insertion of a T tube serves the purpose of function quite well.

In stricture or absence of the terminal end of the common duct the authors are of the opinion that transplantation of the duct into the duodenum should be the first operation tried.

The third type of defect is more difficult to repair than the first two largely because anastomosis of the duct at the hilus of the liver cannot be achieved with ideal technique. The insertion of a vitallium tube with the funnel end projecting into the stump of the common hepatic duct at the hilus and the lower end protruding into the common duct, as first performed by Clote is the procedure of choice.

When no remnants of the external duct can be found the problem of repair becomes much more difficult. The only possible method of repair is to anastomose the stump of the common hepatic duct

at the hilus of the liver to a loop of intestine. Its ability to obtain a good anastomosis and the lack of an appreciable amount of duct wall are largely responsible for the poor results in plastic procedures when no duct can be found. Cholangitis is the pathological lesion feared in any repair of this type, while an even greater danger is the development of multiple abscesses of the liver. The authors are of the opinion that in addition to the tendency for stricture formation to occur reflux of food and intestinal secretion into the intrahepatic ducts is very important in the development of cholangitis. Therefore they attempted mechanically to prevent reflux of food up through the line of anastomosis into the liver by isolation of the area from the food stream.

Two methods of reconstruction were employed to accomplish this: (1) anastomosis of the hepatic stump to an arm of the jejunum after the Roux principle and (2) attachment of the hilus to a loop of jejunum in which an anastomosis is performed between the two loops at a distance from the hilus anastomosis. Better results were obtained by anastomosis according to the Roux principle with the single arm of jejunum. The stump of the hepatic duct at the hilus is approached by staying close to the ventral surface of the liver and working from the lateral side. After the stump is located the jejunum is severed about 2 foot or more from the ligament of Treitz. The distal end is closed by inversion with a single line of continuous catgut suture. The end of the proximal loop is then anastomosed to the distal loop at least 5 feet from the end which is to be attached to the duct at the hilus of the liver. If the mesentery of the distal loop of jejunum is not long enough to permit approximation to the hilus of the liver without tension an opening is made in the mesocolon and the arm of jejunum is drawn up through this opening. The opening of the common hepatic duct at the hilus is dilated to a size which will allow introduction of the funnel end of the vitallium tube. The right and left hepatic ducts can be located by probing and occasionally the duct will be found to divide so close to the hilus that the ordinary tube will be blocked by the septum between the ducts. Under such circumstances a tube with a Y-end should be used so that each duct is cannulated. A purse string suture of silk is placed around the end of the duct and the tube inserted. Tying the suture should anchor the tube securely. A purse string suture is then applied around the center of the line of closure at the end of the arm of jejunum. A small opening is made about 1 inch from the end of the jejunum and with a curved Pean forceps inserted into the jejunum and out through the closed end, the end of the vitallium tube is grasped and pulled into the end of the intestine. The purse string suture is then tied. Interrupted sutures anchor the end of the intestine against the hilus of the liver. Two or three valves or baffles are made in the arm of the jejunum to prevent upward reflux of the intestinal contents.

Anastomosis of a loop of jejunum to the stump of the hepatic duct at the hilus requires less operating time than the anastomosis of the Roux type but 3 of 4 patients surviving this type of operation developed chills and fever after a variable time. This type of anastomosis is not recommended unless an effective valve or baffle is placed in both arms of the loop particularly on the proximal side. An enterostomy must be made between the two loops of intestine at least 12 inches away from the anastomosis between the duct and the jejunal loop.

The authors have inserted 14 vitallium tubes in the treatment of stenosis or absence of the common duct. In 5 cases the Roux Y principle was used. The results in 4 of these 5 patients were from good to excellent. The results following the use of a loop of jejunum for the anastomosis were not so satisfactory. Chills and fever were common. In 3 patients the proximal loop of the jejunum was interposed at a later operation following which there was abrupt cessation of the chills and fever in 2 patients. The operative mortality for 14 cases was 14.3 per cent.

It is concluded that the best operation in the type of patients in whom no common duct can be found is anastomosis of the stump of the hepatic duct to a single arm of the jejunum which is at least 24 inches long and the walls of which have been folded to produce valves or baffles. Prevention of obstruction by the use of a tube did not prevent the occurrence of chills and fever unless reflux of the food was prevented by the operative procedure. The vitallium tube has a definite place in reconstruction of strictures and absence of the common duct, but it is indicated primarily in patients in whom no common duct whatsoever can be found and in patients in whom the common hepatic duct cannot be found.

JOHN L. LINQUIST M.D.

Brunschwig, A. and Bigelow R. R. Advanced Carcinoma of the Extrahepatic Bile Ducts; Cholangiocholecystocholedochectomy. Ann. Surg. 1945 123 535

Seven patients presenting advanced carcinoma involving most of the extrahepatic bile passages and extending into the gall bladder and without apparent diffuse peritoneal spread or hepatic metastases, were subjected to radical resection of these ducts and of the gall bladder. In one instance a portion of the head of the pancreas was also resected. The purpose was to ascertain if palliation might be afforded in this rather hopeless condition if most, or all, of the macroscopic neoplasm was removed.

The procedure was a cholangiocholecystocholedochectomy was carried out under continuous spinal anesthesia supplemented by ethylene and ether if necessary. It consisted of

- 1 A high midline or reverse-L incision
- 2 Aspiration of the gall bladder if necessary to facilitate access to the porta hepatis.
- 3 Dissection of the gall bladder from the liver bed and if it was extensively involved by carcinoma,

wedge shaped resection of a portion of the liver about the gall bladder

4 Application of hemostats to the gall bladder and traction upon it to elevate the mass in the porta hepatis

5 Isolation of the lower segment of the common duct behind the duodenum after mobilization of the duodenum and head of the pancreas from the lateral side

6 Transection of the common bile duct behind the duodenum, and incisions into the head of the pancreas to mobilize portions invaded by carcinoma.

7 With the hemostat applied to the upper 1/2 of the transected common bile duct, dissection was carried out upward to free the involved extra hepatic bile ducts from the surrounding areolar tissue. This is the most precarious stage of the operation because of the danger of opening the portal vein or hepatic artery

8 Transection of the right and left hepatic ducts at or just beyond their emergence from the liver and removal of the specimen.

9 Insertion of T tubes or catheters so as to create a junction between one or both hepatic ducts and the common duct stump

Four patients survived the operation from 3 months to 1 year. The icterus cleared or was partially relieved in all. There was some palliation in all patients, but in 1 the general condition was deteriorating.

The results achieved by radical excision in these patients with advanced extrahepatic biliary carcinoma do not permit alteration of the very pessimistic outlook concerning this situation. Although survival was ameliorated in those surviving the operation, survival was probably not significantly enhanced. The possibility of a radical procedure in this region is demonstrated, and its performance in the presence of more localized carcinoma might increase the opportunity for more patients to survive of such patients. On the other hand, the frequency with which icterus may develop in the course of this disease adds greatly to the difficulties of diagnosis at an early stage.

JOHN L. LINQUIST M.D.

Wechsler H. F. and Weimer J. L. Lithiads. A Report of 2 Cases. Trans. Adults. Gastroenterology 1945 5:1

The authors believe it is commonly known that pancreatic calculi are found only in patients of 40 and that the condition is considered as a possibility among the younger age group. However, the authors report one in a white male 28 years of age. Both white male 27 years of age. Both patients had a long history of digestive abdominal pain the symptoms of which began at 8 and 10 years respectively. The disease is slow and progressive and that the demonstration of calc

that the symptoms had been present for a considerable period of time. The etiology is unknown and the authors state that alcoholism cannot be the sole cause of the disease.

Both of the patients had suffered since childhood with intermittent attacks of upper abdominal pain associated with bloating, nausea, and vomiting. The pain was not relieved by eating and it was aggravated by fried or greasy foods, and by a large meal. Between attacks both patients complained of a dull soreness in the epigastrium, especially on arising in the morning. Neither of the patients had lost weight. There was no glycosuria nor jaundice, and no evidence of hyptic dysfunction.

The roentgenological findings in both cases were classical and of the most common type of pancreatic lithiasis. It is emphasized that patients with this condition may have a history of abdominal symptoms dating back to childhood.

EMIL C. ROSTRICK, M.D.

Marcheroni H. A., Rosal C. and Clerici, L. E.: Failure of Surgical Treatment in a Case of Thrombophlebitis of the Splenic Vein (Tromboflebitis de la vena esplenica. fracaso del tratamiento quirurgico en una observacio.) *Rev. As. Med. Argent.* 943 59 20 5

Thrombophlebitis of the splenic vein alone is quite rare. It may be primary due to blood diseases or primary phlebosclerosis; it may be secondary following compression by cysts or tumors, or from propagation of neighboring infections, such as puerperal infection, appendicitis, or ulcer of the stomach; or it may be brought about by retardation of the circulation in general diseases such as cancer, malaria, or tuberculosis, or in a local cirrhosis of the liver.

It is important to differentiate between phlebitis of the splenic vein and that of the portal vein because surgery is indicated in the former and contraindicated in the latter. In phlebitis of the trunk of the portal vein there is at first an ascites which later disappears, hemorrhages from the hemorrhoidal and possibly the splenic arteries, and a collateral circulation around the umbilicus. When these signs do not exist the phlebitis is probably splenic. There is apt to be repeated vomiting of blood in both forms. Diagrammatic sketches of the two forms are given. On opening the abdomen the surgeon should confirm the probable clinical diagnosis by examination of the portal and splenic veins.

Eppinger operated on 14 cases of phlebitis of the splenic vein with the following results: 4 patients lived more than 10 years, 3 lived more than 5 years, 3 died soon after the operation, 2 died in the course of 2 years, and 3 were well a year and a half after the operation but were not examined further.

The authors describe a case in a girl of 13 years who for several years had had repeated attacks of vomiting of clots of dark red blood. She was an intractable patient, and examination and treatment were difficult. On admission she had fever and a

splenic anemia with very great enlargement of the spleen, which decreased in size after each hemorrhage and after the injection of adrenalin. Splenectomy was performed January 19, 1944. On February 3, 1945 she began to have colicky abdominal pain, followed by copious hematemesis and a small rapid pulse. She died on the night of February 3. Histological examination showed that there was thrombophlebitis of the trunk of the portal as well as of the splenic vein.

AUDREY G. MONROE, M.D.

Bukh, H., and With, T. K.: Splenectomy in Chronic Nonleukemic Myeloid Splenomegaly with Report of a Case with Osteoclerosis. *Acta chir. scand.* 943, 91 307

Chronic nonleukemic myeloid splenomegaly is briefly described and a personal case in which splenectomy was performed is presented.

The risk of performing splenectomy on false indications in this disease is stressed, and a survey of 54 cases of chronic nonleukemic myeloid splenomegaly from the literature in which splenectomy was performed is given.

As the result of the operation in these cases very often is death and true benefit to the patient is seldom achieved, splenectomy should be carried out for this disease only on certain narrow indications.

To avoid splenectomy on false indications, splenic puncture is necessary. It may be carried out with very small risk with the technique of Emile-Weli and his collaborators. In all cases of Banti's disease (even apparently typical ones) in hemolytic jaundice and in essential thrombopenic purpura, splenic puncture should be carried out before splenectomy is decided upon.

MISCELLANEOUS

Hudson, H. N. G.: Closed Intra Abdominal Injury. *Br. M. J.* 943 4 9.

Three cases of visceral injury resulting from three different types of blunt force to the abdomen are reported. In one instance the jejunum was ruptured as the result of a sharp glancing blow on the relaxed abdomen. In another case rupture of the full stomach by force of a powerful crushing nature was fatal. In the third case the spleen was ruptured as the result of a sudden kick on the elastic overlying ribs.

WALTER H. NADLER, M.D.

Ewing, W. M., and Betts, R. H.: Thoracoabdominal Injuries. *Ann. Surg.* 943 793.

Thoracoabdominal injuries have shown a uniformly high mortality rate. Jolly reported a mortality of 61.5 per cent in 26 cases and Allicke, in reviewing 83 cases from the Turkish and Italian campaigns, found a mortality rate of 48 per cent. Inasmuch as recent reports of abdominal or wounds have shown a considerable decrease in mortality from the results of World War I and thoracic injuries in the present war have not been fatal as often as formerly, the author believes that thoraco-

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abdominal injuries should likewise show a reduction in mortality rate.

A true thoracoabdominal injury signifies that the missile has traversed both the pleural and peritoneal spaces and has penetrated the diaphragm. The author believes that if separate missiles have entered each of the cavities and the diaphragm is intact, the condition should be termed a combined thoracic and abdominal injury.

In a 10 month period during the Italian campaign in 1943 and 1944 31 thoracoabdominal injuries were treated by a thoracic surgical team in a field hospital. The patients had been seriously wounded and could not safely be evacuated. Of the 31 patients, 19 were operated on with 6 deaths a mortality of 30.7 per cent. Two were not operated upon. Of these, one was transferred to another installation. The second patient had a left thoracoabdominal injury a right traumatic thoracotomy traumatic amputation of the right arm and a serious right thigh wound. In spite of 3500 c.c. of blood and 500 c.c. of plasma, the blood pressure never was attained and the patient died 5 hours after injury without coming to surgery.

In 10 cases the lesion was on the right side and in 18 cases, on the left side. One case was bilateral, the same missile having traversed the abdomen and both pleural cavities. In the 10 right sided cases the liver was injured in every instance and was practically the only organ involved. The right kidney and adrenal were each injured once. Of the 18 left sided cases the spleen was injured in 10, the stomach in 8, the pancreas colon in 8, the liver in 7, the jejunum in 4, the pancreas in 2 and the adrenal in 1 case. In the patient with bilateral injury the liver was the only abdominal organ involved.

In 22 patients the injuries were produced by fragments of high explosive shells or bombs and in 7 by bullets.

The authors state that sufficient evidence of thoracoabdominal injury to indicate operative interference is in most instances unmistakable. Thoracic involvement is usually apparent—a through and through wound of the costal cage or roentgenographic evidence of an intrathoracic foreign body. Abdominal injury by a missile whose site of entrance is thoracic may be more difficult to determine. Penetrating chest wounds may leave doubt as to the presence or absence of peritoneal perforation. Penetrating missiles must be located by posteroanterior and lateral x rays.

In questionable cases, physical signs are of little aid. Abdominal pain and rigidity are so often present in thoracic cases that injury to a hollow viscus has not occurred but occasionally it is present in patients with abdominal injury confined to the liver or spleen, or the large bowel. Pneumothorax and pneumoperitoneum as diagnostic aids are not practical for the acute phase.

It is just as necessary to explore any doubtful thoracoabdominal injury as it is every questionable

abdominal penetration. Even if no hollow viscus is penetrated a damaged spleen may be fatal or an overlooked perforation of the liver may cause a bile erysipema. Any missile larger than 3 mm. in the liver may produce enough damage to warrant exploration.

The choice of surgical approach depends on three factors (1) whether more extensive damage is expected in the chest or in the abdomen (2) whether the damage can be repaired easier from above or below and (3) the personal choice of the physician which is dependent upon his training and experience.

The advantages of the transthoracic approach are (1) if there is much thoracic damage as well as abdominal damage the thoracic part cannot be done from below (2) certain upper abdominal lesions are more easily handled through the diaphragm (3) the diaphragmatic repair is best accomplished through a thoracically (4) it permits exteriorization of the colon through a subcostal gridiron incision than if a greater distance from the operative incision than if a celiotomy is done (5) postoperative pain is less severe from a thoracotomy than from a celiotomy (6) the patient can be carried in light anesthesia (7) although abdominal relaxation is not necessary (7) although not apparent at first, considerable damage to the intrathoracic organs may be present.

Two factors favor the abdominal approach (1) it is indicated to repair lesions of the lower ileum, cecum ascending lower descending sigmoid and hepatic flexure of the colon and (2) if the thoracic disturbance is minimal and operative interference is not indicated abdominal exploration prevents entering another serous cavity.

Certain lesions are best done from above and others from below. The author believes that all questionable cases should be done from above, and that one should not hesitate to do both a celiotomy and thoracotomy. He opposes division of the costal cage to extend a thoracotomy incision on to the abdomen as it makes an unstable chest and increases the chance of postoperative pneumonia.

It is important to secure an airtight closure and stable thoracic cage complete and rapid re-expansion of the injured lung and maintenance of a clear tracheobronchial passage during the postoperative period. If a surgeon cannot accomplish these objectives he should use the abdominal approach.

A skilled anesthetist is a must for thoracocelotomies and the use of an endotracheal gas-oxygen ether closed system is the author's choice.

For a thoracotomy incision the author uses the eighth to the tenth rib depending on the exposure desired.

Careful closure of the diaphragm is essential and the author suggests a two-layer incision with interrupted cotton or silk sutures.

Temporary paralysis of the phrenic nerve by serving enhances healing and the author has observed no untoward pulmonary complications attributable to the diaphragmatic paralysis.

Liver lesions should be packed and drained subcostally in such a manner as to provide dependent

drainage. Failure to do this may lead to bile peritonitis.

Closure of the chest and lung re-expansion are of basic importance in a transthoracic procedure and the author discusses his method of chest closure. In some cases the chest is drained under water usually by 2 catheters one anteriorly and one posteriorly in the second interspace. If not drained the patient must be frequently examined and any accumulation of air or fluid must be aspirated. In the present series the average number of aspirations in drained cases was 2.3 while in the undrained cases it was 0.8. The author does not drain except in unusual cases, and he has found that complete early lung expansion is more often achieved without drainage.

There are 3 important points in regard to the postoperative care of the thoracic phase of thoracoabdominal injuries. The first is removal of air and fluid in the chest until complete lung expansion is achieved. The second problem is that of the removal of bronchial secretions, in many by bronchoscopy at the completion of operation. This was done in 13 of the 29 cases. In the ward signs of excessive bronchial secretion should be combated by supporting the patient's chest to make coughing more effectual. If this is not effective tracheal aspiration by catheter is tried and as a last resort, bronchoscopy. So important is this postoperative treatment that the author feels all members of the thoracic surgical team should be competent bronchoscopists. The third factor is the control of postoperative pain which should not be severe in a thoracocelotomy when the intercostal nerves have been paralyzed. Pain is better controlled by paravertebral intercostal nerve block than by resorting to morphine.

Of the 6 fatal cases 2 patients died of uremia on the third postoperative day. At necropsy this patient had a large infarct of the kidney. One patient died during bronchoscopy after operation probably of "vagal reflex" 1 died on the second postoperative day of a fulminating pneumonia another died of strangulation on the ward the fifth patient died of

uremia on the third postoperative day. The last fatality in a patient with a right pneumothorax, a left thoracoabdominal injury a spleen injury and transection of the jejunum and colon, occurred on the operating table. The patient was in severe shock with gross contamination of the pleural and peritoneal cavities, and failed to survive the operation even with adequate blood replacement.

The average time-lag from injury to operation was 8 hours for the fatal group and 11.4 hours for the nonfatal group which would indicate that probably the more severely wounded died before reaching any roedical installation.

Three of 8 patients with colon injuries died (37.5%) but in only 1 patient was this the primary cause of death. Five of the 18 patients with left-sided lesions (27.8%) died as compared with the figure of 0.1 per cent for the death of the 9 with right-sided lesions. These figures mirror the increased seriousness of left-sided lesions.

The death rate increases with the number of abdominal organs injured. One death in 13 (6.6%) occurred in this series when one viscous was injured, while 5 deaths in 14 (35.7%) occurred when 2 or more abdominal organs were injured.

From these cases the author draws the following conclusions:

1. An expert physician anesthetist experienced in administering intratracheal anesthesia is invaluable for the proper function of a surgical team treating thoracoabdominal injuries.

2. Fatalities rarely occur on the operating table. They are usually the result of postoperative pulmonary complications necessitating tracheal or bronchial aspiration by catheter or bronchoscopy.

3. Pulmonary re-expansion after a thoracic operation is of utmost importance and must be pursued vigorously until the end is attained.

4. Prolongation of the time interval from injury to operation is not as significant in respect to mortality as are the factors of proper anesthesia and postoperative care.

ROBERT R. BUCKLOW M.D.

GYNECOLOGY

UTERUS

McLennan, G. E.: Results of Various Types of Treatment in Adenocarcinoma of the Endometrium. *Am J Obst* 1945 50 354.

The results of treatment in the University of Minnesota Hospital of 225 patients with adenocarcinoma of the uterine corpus have been reviewed. One hundred and eleven of these were seen more than five years ago. No patient has been lost in the follow-up program.

The absolute 5 year cure rate has been 45 per cent including certain patients previously treated elsewhere. The exclusion of the latter patients does not improve the end results.

Poor results are shown to follow the routine use of radium and x ray alone. Certain patients so treated may be salvaged even many years later by hysterectomy for recurrent or persistent carcinoma. Good results have followed the use of total hysterectomy with or without preoperative or postoperative irradiation.

Since the beginning of 1939, only 53 per cent of the patients have been able to go through a planned standardized routine of treatment. The reasons which necessitated modifying the standard therapy are shown in detail. Approximately 70 per cent of the patients were given what might be termed adequate treatment, in the sense that total hysterectomy was performed.

In the past 5 years only 1 patient of the group receiving routine or standardized treatment has died of recurrent carcinoma.

The operative mortality for the entire series has been 5.8 per cent, or 3 per cent, corrected. The results in terms of immediate morbidity and mortality in 38 patients who were given full tolerance doses of deep x ray preceding intrauterine administration of radium and hysterectomy were undesirable. It is suggested that preoperative deep x ray therapy will add nothing to the ultimate cure rates.

No conclusions can as yet be drawn from recent experience with the intrauterine administration of radium and total hysterectomy in 4 to 6 weeks.

The final results in the treatment of carcinoma of the uterine corpus are predetermined to a considerable extent by the nature of the metastases medical and surgical complications age, weight and nutritional status.

EDWARD L. CORRELL, M.D.

ADNEAL AND PERIUTERINE CONDITIONS

Brayfogle, H. S.: Death from Air Embolism following Insufflation. *J Am Med Ass* 1945 129 342

The author reports the fourth case of air embolism resulting from vaginal insufflation during pregnancy

Previously 1 case from Canada and 2 cases from England have been reported in the literature.

In the present case 1 per cent of silver picrate in kaolin was insufflated with a Shelanski insufflator into the vagina of a woman who had been pregnant for a period of seven months. In 5 minutes the patient developed pallor, dyspnea, cyanosis, and sudden collapse. Twenty minutes following the onset of the symptoms the patient died.

Postmortem examination revealed gas bubbles in the right auricle and ventricle of the heart, edema and congestion of the lungs with an infarct in the left lower lobe of the left lung.

It is supposed that air entered the systemic venous circulation at the site of the placental implantation and was carried directly to the right cardiac auricle.

Some experimental work was carried out and it has been estimated that under positive pressure 500 c.c. or more of air was injected into the pregnant uterus within a brief interval, thus producing the fatal air embolism.

CATHERINE B. HERS, M.D.

MISCELLANEOUS

Clayton, S. G.: Carcinoma of the Female Urethra (Review of the Literature and Report of 3 Cases). *J Obst Gyn Brit Empire* 1945 52 508

Urethral carcinoma appears to be more common in the female than in the male. Nichol stated that 149 cases had been reported in males and 262 cases in females. Hamann and Goebel found that it accounted for 0.16 per cent of gynecological carcinomas, but Menville found only 1 instance among 43,000 gynecological cases.

Urethral carcinoma is usually a disease of the postmenopausal woman the average age in 109 cases being 53 years.

The disease is mostly seen in parous women, and following Ehtendorfer most authors have mentioned trauma or chronic inflammatory processes as etiological factors. Urethral carcinoma is sometimes suspected to be a predisposing lesion but in view of the frequency of occurrence of carcinoma, it is hard to be sure that the supposed relation is not merely that of chance.

Whitehouse divided the cases into urethral and vulvourethral types, and the latter are found about twice as often as the former. Whitehouse's account of the gross pathology is still one of the most valuable and it is difficult to add much to his description.

Urethral carcinoma. This is seen in two common forms: (1) in the usual form the growth appears as a malignant ulcer in the urethral floor most often in the distal urethra, and (2) the less common form is that of perirethral induration extending for some length along the urethra with late ulceration.

Vulvourethral carcinoma. This occurs in 3 forms: (1) a vascular papillomatous nodule at the posterior

margin of the urethral orifice (2) a nodule that breaks down to an ulcer in the vestibule and (3) a scirrhous induration around the urethral orifice.

On microscopic examination the neoplasms are found to be of various types: squamous cell carcinoma, columnar cell carcinoma (both simple and adenocarcinoma), mucoid carcinoma and undifferentiated types. In most of the series the squamous cell carcinoma predominates.

Menville has stressed the similarity of the growths to neoplasms of the bladder.

Urethral carcinoma does not produce much discomfort in the early stages and even after severe symptoms appear there is often so much delay before advice is sought that extension to the bladder, vagina or lymph nodes may have already occurred when the patient is seen.

Perhaps the most common of the early symptoms is painful micturition. Difficult micturition or retention may occur in other cases, frequency. Bleeding is a common symptom more especially with micturition. Local tenderness and dyspareunia also occur with the more superficial growths. Some of the patients may report a swelling in the region of the urethra.

On examination the growth may be seen projecting from the urethral orifice or in other cases it may be felt *per vaginam* as a line of induration along the urethra. Enlarged inguinal glands are found in about 20 per cent of the cases at the first examin-

ation. Biopsy is the final and essential step in diagnosis.

As regards the primary tumor, the choice between surgical excision and irradiation is obviously affected by the position and extent of the growth. If the posterior urethra is involved the growth can be excised only at the cost of permanent incontinence. Irradiation has less operative risk, although there is a possibility of both fistula formation and stenosis. The radiosensitivity of the growth varies with its type and although it is generally stated that the squamous cell types are sensitive there is less agreement about the columnar cell types.

As regards the inguinal glands, there is the same choice between surgical excision and irradiation, and also there is fairly general agreement that surgery offers the best results. The nodes are often infected, and the overlying skin may not tolerate the large doses of radiation necessary to reach the glands in their fatty bed.

The results in general are disappointing. Spauld and Parsons, for example, found only 15 survivors among 110 patients after 3 years. Tanning reported 14 cases, and in 2 of these the disease was too advanced for treatment. Of the 12 patients treated, 8 were subjected to irradiation, with only 1 survival, and 3 were treated by excision of the primary growth with Bassett gland dissection; all 3 survived.

Three cases are reported.

DANIEL G. MORTON, M.D.

OBSTETRICS

PREGNANCY AND ITS COMPLICATIONS

Greene, G. G.: Abdominal Pregnancy; 3 Cases Near or Past Term and 1 Case of Early Abdominal Pregnancy. *South M. J.*, 1945 38 74

In abdominal pregnancy the problem of delivering the fetus is usually simple but that of delivering the placenta requires a difficult decision. There are three methods of approach namely (1) marsupialization of the placenta (2) removal of the placenta and (3) leaving the placenta in place. The first has been discarded by most experienced obstetricians of today because of the greater risk of infection in a wound which may be open for many weeks. Removal of the placenta places both the patient and the operator in a dangerous position. On first inspection of the placental attachments one may think that the placenta can be removed with ease, and find, too late that there is an unsuspected attachment which involves a vital area. Such meddling surgery may cost the life of a patient who could have been spared.

The 3 cases of advanced abdominal pregnancy presented bring out what seems the most desirable method of caring for the placenta. In these the cord was cut short and tied. As much of the membrane as could be removed was cut away. The placenta was left intact and the abdomen closed tightly with out drains. Complications may arise and it may even be necessary to do a second operation for removal of the placenta, but this can be done with greater security later as the placenta will be in a degenerative stage and possibly detached and lying free in the abdominal cavity. Occasionally suppuration may occur but this can be taken care of by simple drainage.

Since hemorrhage is a primary consideration whatever the approach the patient should be thoroughly fortified against it prior to operation. Anspach and others have agreed that the optimum time for operation is from 6 to 8 weeks after the fetus is known to have expired. This, of course is desirable if the placenta is to be removed but does not seem necessary in most instances. The placenta will be absorbed by the body if the "hands off" policy is followed.

Abdominal pregnancy can be diagnosed with less difficulty if one suspects it in any case which does not seem just right.

X-rays are very valuable when used in advanced abdominal pregnancy especially when a diagonal or other peculiar position of the fetus is noted.

Alertness of the obstetrician and early diagnosis may save more infants. DANIEL G. MORTON, M.D.

Greene G. G.: A 7 Year Review of Eclampsia with Special Reference to Treatment with Veratrum Viride. *Am. J. Obs.*, 1945 50 427

Of the 150 patients in this review 104 were primigravidae. This group of cases revealed that true

eclampsia is far more frequent in the women in whom chronic kidney damage has been present for some time. Veratrum viride is not of much value. In more than half of the patients the eclampsia began in the antepartum period.

During these 7 years every method of treatment known seemed to have been given a chance at one time or another.

In the year 1937 many cesarean sections were done. It was in this year that the mortality reached its highest peak. Nine sections were done in 20 cases (45 per cent) that year. Seven of the 9 patients expired. Five of the 7 were treated in the hospital for only 24 hours or less before operation was performed. All of these expired. This emphasizes the urgent need for control of the eclampsia before any operative measure is attempted.

Fifteen cases were seen from 1941 to 1942 inclusive. Fourteen of these received veratrum viride. All of the patients recovered. The patients are treated without giving them any morphine or barbiturates. Paraldehyde per rectum is the choice method of anesthesia. It was found that after treatment had been started 50 per cent or more of the patients did not continue to have convulsions or at most they had only 2 convulsions and in a short period of time they were rational and responding to questions.

No attempt at delivery should be made until the convulsions have been controlled and the patient is rational for one or two days. A number of these cases will go into labor spontaneously during this period if not the induction of labor can be accomplished by the simpler methods, with drugs or some minor operation such as rupturing of the membranes. A very small number of cases may not respond to any of these. If the patient is a primipara near term with a closed thick cervix cesarean section can be considered and performed rather safely provided the eclamptic state has been controlled for a time but the patient is beginning to show evidence of returning to her former condition by a rise in blood pressure, an increase in albumin, and casts in the urine. The author does not like to use bag in ductions in primiparas for this or any other reason.

Eclampsia is a complication of pregnancy prevalent mostly among the young negro women in the South as the result of improper prenatal care.

EDWARD L. CORNELL, M.D.

Moscafee, C. G. H.: Placenta Previa. A Study of 174 Cases. *J. Obs. Gyn. Brit. Empire* 1945 52 313

Since 1937 all cases of antepartum bleeding admitted to the Belfast Royal Maternity Hospital have been treated under the direct supervision of the author. In this article he reports the results of the treatment of 174 cases of placenta previa which were classified as to location as follows: Type I (low-lying)

TABLE I METHODS OF DELIVERY

	No. of cases	Still-births or Deaths	Per cent
Artificial rupture of membranes	33	7	3.4
A. R. M. and Willett's forceps	9	9	47.4
Vernon	3	17	77.3
Cesarean section	68	2	1.9
Breech	6	5	83.3
None	7		14.3

50 Type II (marginal), 37 Type III (partial) 46 and Type IV (complete) 41

The physician who first sees a patient with placenta previa is responsible for getting her to a hospital where suitable treatment can be administered. The type of placental implantation can be determined and the program for treatment outlined only after careful vaginal examination. The time when the vaginal examination is made, however is of utmost importance to the final outcome for the baby. Since many cases of placenta previa manifest themselves early in the last trimester of pregnancy and since most of the infant deaths are due to prematurity delay in treatment to allow the baby to grow should increase the survival rate. The author contends that severe hemorrhage particularly in primigravidae, and further separation of the placenta usually follows vaginal examination, and cites several cases of "silent" previas discovered at cesarean section for other conditions. The small hemorrhages which may occur from time to time in the unexamined patient are of little consequence.

If the initial bleeding occurs near term no time should be lost in initiating treatment but several patients were observed from 1 to 14 weeks before being examined. The average birth weight of the infants in the first 47 cases delivered at the time of the first bleeding was 5 pounds 3 ounces with a fetal mortality of 47 per cent, and in the last 47 cases observed and examined later 6 pounds 13 ounces with a mortality of 6 per cent. The total fetal mortality rate was 53.5 per cent, as compared to 51.3 per cent for the previous 4 years.

The author states that the site of the insertion of the umbilical cord into the placenta is of importance in fetal survival. If the cord is inserted low the baby is likely to die, whereas it usually will survive if the cord is attached high, on the portion of the placenta which remains adherent to the uterine wall.

The methods of delivery with the associated fetal mortality are outlined in Table I. The lower segment cesarean section is preferred, but care should be taken that the placenta is located before the uterine incision is made so that it is not incised.

J. ROBERT WILSON, M.D.

Vartan, C. K.: The Behavior of the Fetus in Utero, with Special Reference to the Incidence of Breech Presentation at Term. *J. Obst. Gyn. Brit. Empire*, 1945 52: 47

Studies show that spontaneous cephalic version from a breech presentation normally occurs during

pregnancy. It was formerly thought that breech presentation occurred most commonly when there was a decrease in size of the pelvic cavity but observation of the cases shows that the factors which prevent spontaneous version are the real etiological factors which persist to term.

Three theories formerly held to explain why cephalic rather than breech presentation occurs are contradicted:

1. The statement that the smaller circumference of the breech at term causes it to present in a small pelvis rather than the head is refuted by the observation that presentation is decided long before the fetus attempts to enter the pelvic brim.

2. The theory that the smaller circumference of the fetus adapts itself to the small end of the uterus is refuted by the observation that the uterus at term is not pyriform especially in the multigravida or in hydramnios.

3. The argument that gravity causes the head to present rather than the lighter breech is refuted by the observation that breech presentation is much more common early in pregnancy than later and that the woman's upright position is not constantly maintained.

One thousand cases of breech presentation occurring during some period of pregnancy were observed in a series of 3,875 patients. Breech presentation is regarded as a common occurrence up to the thirty-fourth week of pregnancy, with spontaneous cephalic version between the thirty-first and thirty-third weeks in most cases. In this series spontaneous cephalic version occurred in 680 of 1,000 cases. The incidence of parity on spontaneous version is unimportant; in this series the incidence was equal in primiparas and multiparas. Reversion seldom follows spontaneous version; it occurred in this series in only 15 women, most of them primiparas, of which 3 underwent a second spontaneous version. External version has a higher reversion rate than spontaneous version; of 330 cases in which external version was done 52 per cent (77 cases) had a reversion to breech presentation. Other observers have arrived at figures of 33.3 and 51 per cent. External versions performed after the thirty-third week show a lesser tendency to reversion than those done earlier; among 22 per cent of failed versions in this series, 36 cases presented by the breech at birth, 38 had spontaneous reversion and 13 were reverted by the obstetrician. The majority of persistent breech presentations show an extended attitude at term; a small proportion show very little liquor (in this series 3%); most of them occur in primiparas (31 in this series).

Spontaneous podalic version occurs occasionally; it was observed in 134 cases (3.4% of the total of 3,875) and in 45 of these it occurred as an initial movement, one-fourth of the cases readjusting themselves. No organic or other factor was suggested as influencing spontaneous podalic version. External podalic version was performed in 2 cases of the total of 85 breech presentations at birth. In 1 of the 31 unheralded breech deliveries the infant was stillborn.

Patients should be informed that the breech presentation is normal at a certain stage in the pregnancy furthermore it should be realized that spontaneous version occurs in 3 out of 5 patients. The cause of spontaneous version is not as easy to explain as the cause of its nonoccurrence. It apparently happens that spontaneous version does not occur (1) when the fetus is abnormal or premature, (2) when there is little liquor (3) when the limbs are extended and (4) when twin fetuses mutually prevent each other from turning.

In performing external version one must induce the fetus to undo its extension and then to turn it rather than to attempt to force around an inanimate object of the wrong shape. Gentle cephalic pressure will induce vigorous movements and often undo the extended attitude. Gentle pressure on the facial aspect and backward turning is often successful when forward version fails and may be repeated weekly or oftener. Anesthesia is inadvisable and unlikely to help in most cases. Accidental hemorrhage at the time of version is very rare. The incidence of death because of dystocia in breech delivery is no higher than in the case of vertex delivery. The mortality rises when a difficult delivery is added to a breech presentation, and no woman with a large baby in persistent breech presentation in the extended attitude should be allowed to deliver herself.

Skagrams have been most valuable in breech cases for determining the fetal attitude and the amount of liquor and therefore have aided in the subsequent management of the case whether it be induction of premature labor or caesarean section at term.

PURLEY B. CRASE, M.D.

O'Driscoll, D. T.: Acute Hydramnios. A Brief Survey of the Recent Literature, with the Report of a Case Simulating Concealed Accidental Hemorrhage. *J. Obst. Gyn. Brit. Empire* 1945 52: 496.

Acute hydramnios has been reported 90 times in the literature. The cause is still unknown. The amniotic fluid is generally regarded as of dual origin. On the maternal side the fluid comes from the blood plasma and is probably changed by its passage across the placenta and amnion. The amnion is capable of true secretory activity. The fetus probably contributes by urinary secretion and by transudation from the fetal surface and umbilical cord. Under normal conditions the fetus also probably helps to regulate the amount by its constant swallowing of liquor with the subsequent passage of excess fluid into the fetal circulation and across the placenta into the maternal blood stream.

In hydramnios therefore, pathological conditions both on the maternal and on the fetal side may be etiologic factors.

Analysis of the last 40 cases of acute hydramnios that appeared in the literature revealed the following associated conditions: 8 cases with twins, 7 cases with anencephalus, 2 cases with teratoma of the

neck, 1 case each with multiple deformities, atresia of the esophagus, congenital adenoma of the lung and hydrocephalic anophthalmic monster. The conditions present in the mothers were ascariasis appearing acutely in puerperium, diabetes mellitus and eclampsia.

In this article, the author reports 1 case of acute hydramnios simulating concealed accidental hemorrhage. The patient was delivered of a stillborn anencephalic fetus.

The case is of particular interest because the patient presented a typical picture of concealed accidental hemorrhage. Not until the membranes were artificially ruptured and the amniotic fluid was forcefully extruded was the diagnosis made. The symptoms were sudden severe abdominal pain with vomiting. On admission to the hospital the patient looked pale and shocked. The abdomen was extremely tense hard and tender, occasional painless contractions were palpable. Rectal examination revealed the cervix to be closed. The uterus reached to two fingers below the xiphoid.

The main points in the differential diagnosis between acute hydramnios and concealed accidental hemorrhage are: (1) the duration of the symptoms, with a slower onset in hydramnios; (2) abdominal enlargement, greater in hydramnios; (3) ballottement will favor a diagnosis of hydramnios; (4) in investigation of the previous history; (5) abdominal puncture of the uterus by a fine needle (Courtois).

Other conditions requiring differentiation are ovarian cysts, ascites and multiple pregnancy.

The treatment of acute hydramnios is usually conservative. If the fetus is normal, an effort is made to carry the pregnancy to term. This can be done occasionally by frequent decompression of the uterus by the technique of Courtois. If the pregnancy is at term or the fetus is deformed, labor may be induced.

Drainage of the fluid, either through the abdomen with a needle or by rupture of the hind waters with a Drew Smythe catheter, is recommended by the author as a desirable method of inducing labor.

The author concluded that acute hydramnios occurs in patients who would develop hydramnios in any case but because of the introduction of an additional factor the symptoms arise acutely. The additional factor is a uterine musculature that is oversensitive to undue stretching caused by the presence of an extra amniotic sac or trauma.

HARRY FIELDS, M.D.

Burch A. E.: The Association of Erythroblastosis Fetalis and Accidental Antepartum Hemorrhage. *J. Obst. Gyn. Brit. Empire* 1945 52: 495.

It is concluded from the evidence in two series of cases that Rh negative women are abnormally prone to have accidental antepartum hemorrhages. It is also postulated from the series that the ensuing placental damage may be the factor which produces erythroblastosis in the offspring by allowing the transplacental passage of antigen and agglutigen. In 2 of 3 cases of erythroblastosis fetalis in the Queen

Charlotte Hospital series reported there was an associated premature placental separation and ante partum hemorrhage the association of two such rare conditions seemed significant although the number of cases was small.

Among the 10 cases of accidental antepartum hemorrhage reported from St. Ulge's Hospital 5 of the women were Rh negative and had Rh positive husbands and 3 had anti Rh agglutinins. Three of these women had a hemorrhage just prior to delivery and 1 of them had a jaundiced baby. 1 gave birth to a child with gross hydrops, and the third had a stillbirth. Two of the women had a hemorrhage some weeks before delivery and both had stillbirths. In all but 1 of the cases there was an association between (1) the time between delivery and bleeding, (2) the severity of the erythroblastosis and (3) the titer of the agglutinins. This suggests possibly the advisability of an early induction of labor when agglutinins are present in the mother in order (1) to prevent hemorrhage in the mother or (2) to prevent erythroblastosis in the infant, but this must be balanced against the risk of prematurity.

The importance of the Rh testing of mothers is stressed especially because Rh negative mothers are prone to have hemorrhages on account of their immunization and run the risk of incompatible transfusions.

In explaining the disproportionately low incidence of erythroblastosis in the offspring of even Rh negative women authorities are quoted as stating that (1) many marriages are childless or produce only 1 child (2) there is a variable potency of the Rh antigen in the infant which produces agglutinins in the maternal blood (3) there is a variable ability of the placenta to prevent the passage of the antigen (4) there is variable maternal response to the introduction of the Rh antigen into the blood stream and (5) there is a variable ability of the placenta to prevent the passage of the agglutinins.

PHILIP B. CHASE, M.D.

Soloway H. M.: Control of Syphilis in Pregnant Women. *J Am Med Ass* 1945, 129: 500

The Illinois Department of Public Health has reported the results of its plan for the prevention of congenital syphilis.

The plan calls for a blood specimen from every pregnant woman to be sent to an approved laboratory for serologic examination. The report is sent to a central agency which contacts the family physician. Information in regard to treatment as well as the necessary drugs are provided if so desired. In addition, every facility to assure adequate treatment and follow-up is provided for the physician.

Adequate information was available in 1,445 cases. In the remaining 243 it was considered inadequate for a variety of reasons.

The most significant finding was the relationship of the outcome to the onset of treatment. When treatment was started before the end of the fourth month the total fetal loss was 6 per cent. Treatment

delayed until the fifth month yielded a fetal loss of 17 per cent. Beyond that time the fetal loss reached 49 per cent and in the absence of treatment it increased to 73 per cent.

Reactions to antisyphilitic treatment seemed insignificant. There were no fatalities, although 25 serious reactions were reported.

This report stresses the well known fact that congenital syphilis can be prevented by early diagnosis and adequate treatment. In prevention of congenital syphilis the emphasis should be placed on early detection. This can be accomplished if the patients are educated to seek early prenatal care and if the physician does a routine serologic test. Once the disease is diagnosed every effort must be made to carry out adequate treatment and follow-up studies on both the mother and child.

JAMES F. DONOVAN, M.D.

Hudson G. S. and Rucker M. P.: Spontaneous Abortions. *J Am Med Ass* 1945, 79: 512.

Statistics on the frequency of spontaneous abortion vary widely. This study covers 1,000 consecutive obstetrical cases in which there were 108 abortions of all types. When the 25 therapeutic and 2 criminal abortions were subtracted there remained 94 spontaneous abortions, an incidence of 9.4 per cent.

The incidence was then noted in relation to certain factors and compared to the anticipated incidence of spontaneous abortion.

In patients who had had previous children or abortions, the incidence was higher. An increase was noted also in obesity, pelvic inflammatory disease, retrodisplacement, fibroids, hypothyroidism, diabetes, in women who used tobacco and in those who gave a history of previous sterility. The increase was particularly prominent in the last two mentioned instances.

Factors which the authors stated had no effect on the incidence were the marital status, syphilis, acute upper respiratory infections, and falls.

JAMES F. DONOVAN, M.D.

LABOR AND ITS COMPLICATIONS

Mandel, H. S., Graff S. and Graff A. M.: Placental Senescence and the Onset of Labor. *Am J Obst* 1945, 50: 47

Estimation of the nucleocytoplasmic ratio reveals that the placenta ages in a uniform and continuous manner from approximately 8.6 per cent at 2 months to 3.6 per cent at term. The growth of the placenta conforms to theoretical and statistical laws of growth. The toxemias of pregnancy have no effect upon the placental age as measured by the nucleocytoplasmic ratio. Death of the fetus in utero lowers this ratio. I.e., causes increased aging, probably by some ant lytic process.

There is no correlation between placental senescence and the onset of labor.

EDWARD L. COW, M.D.

PUERPERIUM AND ITS COMPLICATIONS

Fulton A. A.: Vitamin C and Lactational Mastitis.
Brit. M. J. 1945 1 458

Of 2 Scottish clinics for pregnant women designed by the author as clinic A and clinic B respectively each served about half of the town, and there was no distinction among the patients received as to social status or other condition. The group of patients attending clinic A who received ascorbic acid is referred to as group A and consisted of 124 women. The patients attending clinic B did not receive ascorbic acid being the controls this group is referred to as group B and consisted of 126 women.

In group A each expectant mother was given 50 mgm. tablets of ascorbic acid daily at about 3 months before the onset of labor and until about 6 months following childbirth. On admission to the Maternity Hospital all of the patients in both groups were given the saturation test for vitamin C as devised by Harris and Abbaay (*Brit. M. J.* 1937 2 1426). The patients in group A required an average of only 1 673 mgm. and those in group B 3 076 mgm. for saturation yet approximately the same percentage (25%) developed mastitis although the former were more favorably situated as regards the two factors considered to be predisposing causes of mastitis in lactating women primiparity (in from 47.6 to 52.4%) and delivery in the hospital (15 women of group A were delivered at home).

From these results it would appear that vitamin C administration per se has no influence in reducing the incidence of mastitis.

The subsequent tests on the patients with mastitis after the saturated state had presumably subsided from the first saturation tests (in about 3 weeks) showed that (as in the first test) on the average of 1,410 mgm. of ascorbic acid were required to saturate the patients of group A and 3 117 mgm. were required to saturate the patients of group B. The saturation test according to the standard of the League of Nations showed that 63.7 per cent of the cases of group A reached the saturation stage within

2 days of the beginning of the test period whereas all of those in group B reached this state but at a much later date.

The patients in group B were even in a somewhat better condition with regard to the severity of the mastitis because the process subsided without suppuration in 9 of the women in group B but in only 3 of those in group A.

The author admits however that there are a number of vitiating factors at work in this study the most important being perhaps the fact that no account was taken of the possible effects of other food deficiencies in these patients and also the fact that the vitamin C administered was synthetic whereas it is possible that the maximum benefit may be obtained only when it is given in the form of natural foods.

JOHN W. BRENNAN, M.D.

NEWBORN

Gamble, T. O., Miller, L. C., and Tainter, M. L.: Benzyl Penicillin; Clinical Toxicity and Efficacy by Mouth in Impetigo in the Newborn Infant. *Am. J. Obst.* 1945 50 514

The benzyl ester of penicillin given by mouth quickly cleared 16 attacks of impetigo contagiosa in 15 infants in a maternity hospital and terminated a protracted epidemic.

This new form of penicillin is stable at room temperature and can be supplied to the physician ready for use. It is as effective by mouth in impetigo as is the sodium penicillin administered by injection. The great advantage of being able to give benzyl penicillin orally marks a major advance over the previous injection therapy in managing this difficult condition. The new therapy avoids staining the skin and linen as in the treatment with dyes and also does not require the painful surgical removal of crust as in the local therapy of impetigo.

The effectiveness of benzyl penicillin demonstrated in this study points out the need for extensive tests of this preparation in other types of infection.

EDWARD L. CORNELL, M.D.

GENITOURINARY SURGERY

ADRENAL, KIDNEY AND URETER

Huff, F. M., and Boger W. P., Jr: Renal Hypoplasia with Hydroureter and Primary Amenorrhea. *J Urol. Balt.*, 1945 54: 6.

The frequent coincidence of genital and upper urinary tract anomalies has been noted and reports of many cases have emphasized this combination of abnormalities.

The case here presented is of interest by reason of left renal hypoplasia, a greatly dilated and tortuous ureter with a stricture of its intramural portion, aberrant vessels crossing the lower ureter and primary amenorrhea, assumed to be due to congenitally defective internal genitalia.

While renal hypoplasia is not uncommon, the great ureteral dilatation found with it in this instance is unusual. The futility of endocrine therapy in this case strongly suggested an end organ structurally incapable of response. From this experience it would appear that the complaint of primary amenorrhea justifies investigation of the urinary tract.

JOHN E. KIRKPATRICK, M.D.

Newman H. R.: Renal Disease in AAF Regional Station Hospital. *J Urol. Balt.*, 1945 54: 126.

The incidence of renal disease is considered to be at the lowest figure during the draft age of from 8 to 38 years.

The present study includes 17 cases of renal lesions in patients between the ages of 18 and 38 years. This study reveals the large number of cases of renal disease which may be encountered in an average sized station hospital (approximately 500 beds) over a period of 12 months. In this period of time there were approximately 475 urological admissions, and about 1,500 patients were seen as out patients. Patients with venereal disease were not included on this service.

The renal lesions most often encountered were congenital anomalies, infections, and calculi on the other hand nephropathosis, albuminuria, hematuria of unknown origin, nephritis, and tuberculosis were found to be relatively uncommon.

JOHN E. KIRKPATRICK, M.D.

Nesbit, R. M., Keltner, W. A., and Lynn, J. M.: The Prognosis of Renal Tuberculosis Treated by Nephrectomy and the Outlook of the Patient Who is Considered Unsuitable for Operative Treatment. *J Urol. Balt.*, 1945, 54: 27.

Data are presented on 260 cases of genitourinary tuberculosis which have been followed for a period of 5 years or more. It is pointed out that in this series males were affected more frequently than females, in a ratio of about 2 to 1 and that the urine in about one-third of the cases was secondarily infected by organisms other than the tubercle bacillus. Fifty

and three tenths per cent of the nephrectomized patients are living an average of 11 years after operation, while 81.3 per cent of the patients not operated upon have died in an average of 3 years. The authors were unable to demonstrate that an accompanying genital complication in the male adds to the mortality of renal tuberculosis and they assume that the higher death rate among males is due to the higher mortality of tuberculosis generally in this particular group.

Three facts derived from these figures have proved to be statistically significant.

1. In nephrectomized patients, a lower rate of survival is found in the group in which acid fast bacilli have been demonstrated in the urine from the kidney not operated upon, by guinea pig inoculation, than in those with normal urine on the "sound" side.

2. In tuberculosis of the urinary tract the survival of females is greater than that of males.

3. The mortality rate of genitourinary tuberculosis is adversely influenced by the presence of bone and joint, or pulmonary lesions. JOHN A. LOER, M.D.

Doornmaashkin, R. L.: Cystoscopic Treatment of Stones in the Ureter with Special Reference to Large Calculi, Based on the Study of 1,534 Cases. *J Urol. Balt.*, 1945, 54: 245.

The author presents a series of 1,530 cases of ureteral calculi, situated at all levels of the ureter and renal pelvis, and lists the results obtained by cystoscopic manipulation in 1,533 cases.

The methods of nonoperative treatment of ureteral stones are classified and evaluated by the author as follows:

Indwelling ureteral catheter. This does not produce dilatation of the ureter adequate enough for the passage of large calculi. It is of distinct value, combined with the administration of sulfa drugs, in cases in which renal infection is a complication of urinary blockage, and should be utilized in these cases prior to attempts to dilate the ureter with rubber bags and metallic dilators.

Methods for forcible removal of ureteral calculi. These include the use of metallic hooks, cages, and baskets and are condemned for general use, as they are dangerous in both theory and practice, resulting in serious damage to the ureter in many instances.

Dilatation of the ureter. This is done at or below the level of the calculus to a degree adequate to allow passage of the stone. It was the method of choice in the management of ureteral calculi in this series of cases.

For the purpose of determining the results of intra-ureteral manipulation, the stones were divided into two large groups. A, small calculi, measuring less than 5 mm. in width, and B, large calculi, measuring 5 mm. or more in width.

There were 780 cases in group A. Tabulation of the results shows that excluding 48 cases of spontaneous passage of stone, 41 cases which were lost to observation and 2 cases in which no cystoscopic manipulation was attempted because of the severity of the renal infection and in which nephrectomy was done, there were only 2 of 689 cases treated in which the cystoscopic manipulation failed or that a successful passage of stone followed cystoscopic intervention in 99.7 per cent of these cases. Six cases of complete anuria were observed in this group, 4 cases showing bilateral calculous obstruction and 2 showing anuria of apparently reflex origin.

There were 741 cases in group B. There was spontaneous passage of the stone in 19 cases and 24 cases were lost to observation. Intraurethral manipulation was successful in 484 cases or 85.9 per cent. The principle of providing ample room for the downward passage of the stone at and below its level was followed in this work. This was achieved by dilatation of the lower end of the ureter with the author's metallic bougies, and by using rubber bags at the higher levels. There were no instances of ruptured ureter or mortality resulting from instrumentation. Operative removal after cystoscopic manipulations had failed was necessary in 80 cases or 14.1 per cent.

In 134 cases of group B operation was performed without a preliminary attempt at cystoscopic manipulation for one of the following reasons: the stone being obviously too large, acute infection, advanced chronic infection and hydronephrosis, an emergency (hemorrhage, impending anuria, or ruptured kidney), a large renal calculus requiring operation associated with a stone in the upper ureter on the same side, renal destruction on the opposite side due to a renal calculus associated with a fairly large stone in the lower end of the ureter, bad impaction, and anatomical anomaly of the urinary tract, ureteral stricture, empyema of the ureter following nephrectomy, the association of stone with renal tuberculosis, or the patient's refusal of cystoscopic treatments.

WILLIAM W. SCOTT, M.D.

Lazarus, J. A., and Marks, M. S.: Primary Carcinoma of the Ureter with Special Reference to Hydronephrosis. *J. Urol.*, Balt., 1945, 54, 140.

In 1934, after a careful search of the literature one of the authors was able to collect 68 cases of primary carcinoma of the ureter, including 3 of his own. Since then 115 additional cases have been reported, which indicates an increased alertness on the part of urologists to the possibility of this disease rather than an actual increase in incidence.

Of the total number of tumors 49 per cent were of the nonpapillary type. Malignant neoplasms were situated in the lower segment of the ureter in approximately 50 per cent of the reported cases, and were associated with ectasia of the renal pelvis in 46.4 per cent and of the ureter in 43.7 per cent because of the tendency of these tumors to occlude the lumen of the ureter. The greatest prevalence of this disease oc-

curred in the sixth and seventh decades. Ureteral carcinomas show marked invasive and metastasizing tendencies, particularly to the regional lymph nodes (28.9 per cent), liver (14.9 per cent) and bones (12.8 per cent).

Although pain, hematuria and the presence of an enlarged kidney are supposed to constitute the characteristic triad of symptoms of this disease, it was found that hematuria alone was by far the outstanding symptom, having occurred in 70.5 per cent of the collected cases. A clear cut and persistent filling defect in the ureterogram, especially when associated with ectasia of the segment of the ureter directly above such a defect in the authors' opinion, constitutes the only pathognomonic sign of ureteral tumor.

The chances of demonstrating filling defects in ureterograms would be enhanced if repeated attempts were made to obtain good ureterograms in all cases which (1) disclose an obstruction in the ureter, (2) bleed through the ureteral catheter as a result of manipulation at the site of the obstruction, and (3) fail to disclose a calculus at the site of the obstruction. Failure to recognize the presence of this disease has led urologists to remove hydronephrotic kidneys only to learn later to their great chagrin that the hematuria had recurred and necessitated a second operation for the removal of the tumor bearing segment of ureter.

The procedure of choice in the treatment of this disease is complete extraperitoneal nephroureterectomy. It is recommended that a cuff of vesical wall surrounding the ureteral meatus also be removed in cases in which the tumor is situated low down in the ureter and especially when the ureteral meatus is involved.

A careful review of the literature has further strengthened the authors' belief in the dangers of incomplete urological surveys for so-called minor urological complaints and a detailed history is given of a case in which the patient was perfunctorily treated on and off for 15 years for cystitis without being subjected to a thorough urological survey. It is believed that the lesion which was found could never have progressed to such large proportions had ureteral catheters been passed during one of the episodes of so-called cystitis.

JOHN E. KIRKPATRICK, M.D.

BLADDER, URETHRA, AND PENIS

Lewis, L. G.: The Treatment of Bladder Dysfunction after Neurological Trauma. *J. Urol.*, Balt., 1945, 54, 284.

The author reviews the anatomy and innervation of the bladder and the physiology of micturition. He believes that the increase in bladder tone following presacral neurectomy is due to increased vascularity of the bladder wall.

The following principles are outlined for the urological care of patients following spinal injury:

1. No instrumentation for 24 hours

2. Absolute aseptic catheterization at 24 hours if necessary.

3. The use of a urethral retention catheter if a second catheterization is necessary.

4. The use of intermittent or tidal irrigation of the bladder with acid solutions to prevent incrustation cystitis.

5. Perineal urethrostomy in selected cases.

6. The use of a well placed suprapubic tube when definitely indicated for long or permanent bladder drainage. This is indicated in complete transverse lesions below L-1. Six weeks is about the limit of tolerance of the urethra to catheter drainage.

Close co-operation between the neurosurgeon and the urologist is required in the care of patients following severe cerebrospinal injury.

WILLIAM W. SCOTT, M.D.

GENITAL ORGANS

MacLeod, D.: The Glandular Nodules in Benign Glandular Enlargement of the Prostate: Its Development and Cause. *Bril J Urol* 1945 7 85

The evidence in brief of the sequence of events leading to the development of the glandular nodule in benign glandular enlargement of the prostate is as follows:

1. At any one time during the growth of the prostate there are present groups of tubules at times unrecognizable which arise from the terminations of the primary and subsidiary tubules of the prostate. They may be collective as in the preperimetric region, or individual.

2. With further increase of the glandular tissue in general, a circumscribed resistance to the growing groups is created in due course by the tissues in which they are situated. It is caused indirectly by a passive force applied to the tissues from the periphery of the prostate as a whole and also from that of the preperimetric region.

3. Growth of the groups against that resisting tissue is accompanied by and causes the formation of, circumscribed capsules of fibrous and/or compressed glandular tissue about them: the groups are thus isolated and so form the glandular nodules associated with the benign enlargement of the prostate.

4. Within the limiting capsules growth of the groups may continue: acinous formation and intra-acinous epithelial proliferation are followed by acinous dilatation and rupture.

The direct cause of benign glandular enlargement of the prostate is continuity of the active glandular growth against a passive and circumscribed resistance derived from the periphery of the prostate as a whole and also from that of the preperimetric region.

The glandular nodule in the benign enlarged prostate is evidence of an attempt to limit the size of the gland.

Peripheral resistance to the glandular growth becomes duly effective in the upper parts of the pro-

state first and in the lower parts last, because of the disproportionate increase of growth in the regions and glandular nodules are in point of time and place likewise formed.

The absence of benign enlargement from the upper part of the posterior lobe of the prostate is due to the destruction of its groups of tubules by pressure from the enlarging lobes in front of it: absence from the lower part is caused by lack of adequate peripheral resistance to its growing groups of tubules.

Benign glandular enlargement of the terminal parts of the lateral lobes of the prostate is equally as rare as the same condition in the posterior lobe and is due to lack of adequate peripheral resistance to the growth of the tubules in those parts.

JOHN A. LOFF, M.D.

MISCELLANEOUS

Yamauchi, S.: Chyluria; Clinical, Laboratory and Statistical Study of 45 Personal Cases Observed in Hawaii. *J Urol* Balt., 1945 54 511

The clinical, laboratory and pyelographic studies based on 45 personal cases of chyluria are carefully compared and correlated with those of the cases recorded in the literature and a comprehensive picture of chyluria is here presented.

The etiology and pathology have been discussed chiefly on the basis of the author's experiences with his own material, hence they represent his own views. This material has been added as an adjunct to the main material and the analysis of the records, to aid the reader in obtaining a comprehensive picture of the disease.

The individuals suffering from chyluria had all been exposed to filariae during their lifetime, but filariae were never demonstrated in their blood, urine or as in some cases, tissues. The long period from the last possible exposure to the filariae to the onset of chyluria (in many of these cases) the absence of eosinophilia (in the majority) and several other factors indicate that filariae probably predisposes the patient to this condition but it does not actually initiate it. However anyone who has been exposed to this nematode becomes a potential candidate for chyluria anytime, even many years after the exposure. Thus, the incidence of this disease can be expected to rise in regions where filariae is not prevalent, such as the northern United States, when armed forces return from regions where it is endemic.

Urinary stasis has been considered as the exciting cause of chyluria. Fornix rupture caused by urinary stasis results in a lymphaticourinary communication, and chyle appears in the voided urine if the ruptured lymphatic vessels already contain chyle. Except in a few instances minimal pathological changes sufficient to form varices are probably present in the lymphatics without definite obstruction to the large retroperitoneal lymphatic vessel and thoracic duct. Pregnancy, endocervicitis and prostatic hypertrophy so frequently found in this condition become logical concomitant occur-

rences instead of bizarre associations when viewed in this light

Chyluria is characterized by the appearance of chyle per se in the voided urine. The presence of fat granules in a colloidal state, the presence of albumin, erythrocytes and lymphocytes, the pyelographic injection of the renal and perirenal lymphatics frequently associated with fornix rupture and pyelovenous reflux, and the control of the condition by repeated intrapelvic lavages with sclerosing solutions support the surmise that there is a lymphatic urinary fistula at the fornix of the calyces.

The control of chyluria can be accomplished without much difficulty by repeated intrapelvic lavages of silver nitrate solutions through infundibular catheters, but the cause of urinary stasis must be removed and fat must be eliminated from the diet after such lavages. The success of such management depends on the extent to which the predisposing and exciting causes can be eliminated.

JOHN A. LOEF, M.D.

Solomon, S.: The Treatment of Gonococcal Arthritis with Sulfonamides and Artificially Induced Fever. *Am J Syph.*, 1945, 29, 567.

Twenty three cases of drug resistant gonococcal arthritis are reported. Of these 10 were treated with sulfonamides and artificial fever in the hypertherm with the following results: 4 were cured and the remainder showed either considerable or partial improvement. Fifteen were treated with sulfonamides and fever artificially induced with intravenous typhoid vaccine with the following results: 6 were cured, 6 were either considerably or partially improved, 3 were not improved, and 2 of the last group were subsequently treated in the hypertherm with good results.

The results with both of these methods were encouraging. The use of the hypertherm is preferable to the use of vaccine. The most important consideration however is early treatment. Hence if the hypertherm is not available, combined vaccine and sulfonamide therapy should be instituted without delay.

It is emphasized that specific therapy does not supplant the regular methods of management of arthritis, which include bed rest, special diet and physiotherapy. Specific therapy is used in addition to these and results in a much greater percentage of cures and in the restoration of joints to useful function.

JOHN A. LOEF, M.D.

Koch, R. A., Haines, J. S., and Hollingsworth, W. Y.: Penicillin in Gonorrhea Treatment and Control. *J Am M Ass.* 1945, 129, 407.

The authors' results do not justify the belief that penicillin is an easy infallible cure for gonorrhea. Penicillin will cure most cases of gonorrhea, but cure is not necessarily accomplished by the first course of the drug or by penicillin alone. Supportive treatment, such as pyrotherapy and sulfonamides is necessary at times. Penicillin failures are frequent enough to warrant diligent search for gonococci following medication, for absence of clinical symptoms is not proof of cure.

Two groups of cases, one under hospital conditions for 8 days and the other under clinic conditions for 9 weeks are compared. The minimum hospital criterion of cure was two negative consecutive cultures obtained by prostatic massage, the last one being made at least 96 hours after completion of the medication and preceded by the provocative passage of sounds. The minimum clinic criterion was three consecutive negative cultures with one week between cultures. The taking of one follow up culture is not conclusive or adequate evidence of cure.

Fourteen per cent of 485 patients treated with an initial course of 200,000 units of penicillin were not cured. Patients with gonococcal epididymitis or prostatitis responded as well to penicillin therapy as those without such complications.

Penicillin is unquestionably the most valuable therapeutic agent thus far available for the treatment of gonorrhea. The medical profession must be aware of the limitations of penicillin therapy, the possibility of producing a carrier state, and the social factors related to the spread of the disease.

DAVID ROSENBLUM, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Bowden, R. E. M.: *Muscle Changes in Denervation and Re-Innervation*. *Brit. M. J.* 945: 487

The muscle changes in denervation and re-innervation are considered from the point of view of histology, electrical reactions, electromyography and the treatment of paralyzed muscles.

In the matter of structural changes, in the early stages (1 to 3 months after denervation) there is a loosening of the compact arrangement of the muscles and an apparent numerical increase of the nuclei; there is some stasis of the blood, the nerve fibers undergo Wallerian degeneration, and the empty Schwann tubes and empty motor end plates remain. After 3 months the muscle fibers atrophy and are replaced eventually by fat and connective tissue; ghosts of muscle fibers, a few capillaries, and the larger nerve trunks may be seen surrounded by fibrous tissue, a few scattered connective tissue tubes containing granules may be all that remain of the muscle fibers. However the changes are predominantly those of atrophy and not of degeneration, and up to one year after denervation it is possible to expect a fairly good degree of functional recovery; from then on the prognosis deteriorates, and as a rule after 3 years the prospects are exceedingly poor. There are, however, notable individual variations: sex, age, mobility of the limb and physical therapy influence the rapidity of the changes.

With regard to the electrical reactions, Erb's reaction of degeneration develops, faradic stimulation is lost and the threshold to galvanic stimuli rises with loss of contractile substance and may finally disappear altogether if atrophy is advanced. The failure to elicit a galvanic response in the absence of edema indicates serious change in a muscle.

On the subject of electromyography the author notes that for about from twelve to twenty-eight days after denervation there is no recordable electrical activity in human muscle on attempted movement or at rest from twelve to twenty-eight days after denervation, however, fibrillation does occur; this is shown by rhythmic, fine spikes on the tracing, which are totally unrelated to attempted voluntary contraction. Fibrillation persists as long as any contractile denervated fibers remain or until re-innervation is taking place.

Faradic stimulation is useless; the denervated muscle however responds to galvanism, and this is, therefore, one method of treatment. Electrotherapy not only should be regular and adequate but should begin as soon as possible after injury. Physical therapy is also of value in the prevention of contractures in the paralyzed muscles, daily movement throughout the whole range of the joints of the limb should be carried out, and splinting of paralyzed

limbs is never done to obtain immobilization unless there is a fracture or an unhealed wound.

However, whatever the treatment, the degree of functional recovery will depend on the nature of the lesion in the nerve. When the trauma or lesion to the nerve has not been sufficient to interrupt the supporting tissues of the nerve, although the trauma has been sufficient to cause complete peripheral degeneration of the axons, good powerful independent muscle action may be restored, but the pattern of innervation will be slightly abnormal. When, however, the nerve has been more seriously damaged there may be partial disruption of the Schwann tubes and scar formation; then there will not be as even an advance of regeneration axons and some permanent weakness and atrophy may be expected. In complete division of the nerve no recovery can take place without surgical intervention, which should be undertaken as soon as possible. Even so, some scar tissue will result at the suture line, with unavoidable confusion of the axons at this point, the number of nerve fibers reaching the end organs being thus diminished.

Motor unit action potentials may precede recovery of voluntary function by as much as 3 months; this observation in isolated instances, nevertheless, is no guarantee that further re-innervation is going to occur. Still, the finding of both fibrillation and motor unit action potentials indicates a partial or recovering degenerative lesion of the lower motor neuron.

A good functional recovery is possible while the electrical reactions are still abnormal.

JOHN W. BENDIS, M.D.

Jackson, E. C. B., and Seddon, H. J.: *Galvanism and Denervated Muscle Atrophy*. *Brit. M. J.* 1945, 485.

The results of electrical stimulation in the treatment of lower motor neuron lesions in general warrant the formulation of certain conclusions:

1. Muscle atrophy begins very soon after denervation and at first proceeds rapidly; then it gradually slows down as the time after denervation increases.

2. Interstitial fibrosis is a constant feature of denervation atrophy and it follows that the greater the atrophy and the fibrosis, the poorer the ultimate functional recovery. It follows that if atrophy can be prevented or controlled there is a greater likelihood that recovery will be satisfactory.

3. As yet there is no evidence that fibrosis is irreversible. The treatment to prevent it should be started as soon as possible after denervation and continued until re-innervation has occurred.

4. The precise nature of denervation atrophy is still unknown. Disuse and a consequent impairment of nutrition undoubtedly play an important part.

Fibrillation has been regarded as an important factor in throwing out and causing atrophy of the de

5 It has been conclusively shown that muscle wasting can be controlled to a very considerable extent by repeated electrical stimulation with a stimulus of comparatively long duration Galvanism has several disadvantages but it is the only type of stimulus of long duration generally available it was used in the investigation.

6 The treatment must be intensive both in the strength of the stimulus and in the number of contractions at each session and it must be continued over a long period to be effective.

7 Galvanism is of greater value in the prevention of wasting when it is applied early It has been reported that even the most intensive treatment did not altogether prevent atrophy

8. In the treated muscle the muscle fibers remain comparatively large. The interstitial tissue does not increase to any great extent and if reinnervation occurs, functional recovery is good. In untreated muscle the fibers shrink rapidly fibrous tissue appears between them, and recovery is poor

The rate of wasting in man after denervation is unknown. Adequate stimulation is limited by the large size of many muscles and other factors. This article describes the end results when 164 patients were examined in 92 of whom it was possible to obtain readings with sufficient frequency to be of value Of these 54 were suffering from complete nerve lesions The results are based upon the findings in these 54 cases Ulnar paralysis was present in every case in 18 per cent of those treated with galvanism and in 20 per cent of those not so treated, there was also paralysis of the muscles of the hand supplied by the median nerve.

Half of the cases were treated with galvanism and the other half without galvanism. Five charts are presented which show that in each period up to 400 days there was a steady loss of volume in the untreated muscles the rate of loss gradually diminishing until after 400 days when there was little change Galvanism was not effective during the first 100 day period Galvanism was almost completely effective in preventing wasting at all other times. There is no doubt that the volume of the hand is better maintained when the retarded muscles receive regular galvanic stimulation.

The beneficial effect of galvanism is most noticeable early rather than late after denervation. It follows that the earlier treatment is started the better the result. Galvanism at best prevents a decrease in the muscle volume. It follows that what ever has been lost from delay cannot be regained During the first 100 days, galvanism does not prevent wasting. It only retards it. Without galvanism, wasting proceeds faster in the first 100 days than at any other time. It is never too soon to begin galvanic stimulation. If the paralyzed part must be enclosed in plaster windows should be cut to permit early application of electrodes to affected muscles

The cases in this study were treated six times a week. Recordings were also made in cases treated three times a week. In addition recordings were made when there was considerable variation in the technique The good results were in direct proportion to the amount of treatment. Galvanism is of real value and success depends largely on the frequency of treatment. The treatment consisted of the application of 90 stimuli per day for 6 days a week The stimuli were strong enough to produce a brisk contraction They were given at the rate of 30 per minute with an interval of 1 minute between each group of stimuli to permit recovery from fatigue

RICHARD J. BENNETT JR. M.D.

Goodnick, L. T.: Solitary Myeloma; Review of 61 Cases. *Radiology* 1945 45 385

The prognosis of solitary myeloma is much better than that of multiple myeloma. Judicious irradiation produces relief of the symptoms and prolongs life.

Sixty-one cases in the literature are reviewed of this number 2 were the author's The average age of the patients was 50 years. The ratio of males to females was 2 to 1 The ilium femur humerus and thoracic vertebrae were the most common sites involved The chief complaint was a localized pain gradually increasing in severity Pathological fracture under increased stress and strain or trauma was frequent A palpable mass was present at times Solitary myeloma did not produce a generalized weakness and anemia as seen in multiple myeloma Hyperproteinemia, renal damage, and low blood pressure were rare.

Roentgenologically there are two types of solitary myeloma. The first resembles, and is frequently interpreted as a giant cell tumor The lesions are cystic and trabeculated within the medulla of the long bones or pelvis the cortex is expanded and pathological fractures are frequent. The second type is characterized by bone destruction. The pathology in both types is plasma cell myeloma.

All types of therapy have been tried Forty three cases were treated by irradiation following biopsy and curettage. As many fields as possible were used and the dose was fractionated from 300 to 500 r per portal for a total dose of from 1,000 to 3,000 r The course of therapy could be repeated whenever necessary Relief from symptoms was obtained in all but 2 cases. In 39 cases recalcification was demonstrable with x rays. Generalized spread occurred in 14 cases.

In this series 27 patients survived and 16 died Of 15 who died (1 died of a cardiac lesion) all but 1 lived more than 2 1/2 years from the onset of the symptoms. The average duration from the onset of symptoms was 7 years, and the lapse of time from hospital admission to death was 3 years and 9 months for the solitary myelomas In contrast to 14 months for the multiple myelomas.

Most authors believe that the duration of life is dependent on the transition of the lesion from the

solitary, the multiple type of myoma. Solitary lesions tend to be benign and clear away, whereas multiple lesions are malignant.

MAURICE D. SACHS, M.D.

Koch, S. L.: Injuries of the Hand. *Q Bull Northwest Univ Med School* 1945 9 365.

Simple principles of treatment of hand injuries, early and late, are concisely reviewed and pointedly illustrated.

Immediate cleansing of the area surrounding the wound, then of the wound itself, with soap, water and saline solution prepares a clean field where restraint in débridement is essential. Only if the wound can be closed for primary healing (by skin graft or pedunculated flap if necessary) can deep structures safely be repaired. Fractures may be reduced, but no nerve or tendon suture should be done without assurance of wound healing by primary union. Concerning local chemotherapy with sulfonamides the author quotes Meleney's report and War Department Directives which indicate that extensive clinical trial has proved its ineffectiveness.

Satisfactory late repair of compound injuries rests on three basic requisites which must be faithfully fol-

lowed in spite of all pressure on the surgeon for speed: (1) superficial and deep tissues must be free of infection; (2) all inflammatory reaction and edema must be gone from the affected area; and (3) the general condition of the patient must be optimum for prompt healing of extensive surgical wounds. The period of waiting for these conditions to be realized is important and should be utilized to bring all factors in the final effort to an optimum state. The normal status of the circulation, free joint motion and good muscle tone are essential to a satisfactory end result and all are stimulated by active motion in a warm water bath. Splints are needed to support paralyzed muscles and prevent stretching and can also be used with gentle traction to overcome contractures already present.

A normal soft tissue covering for the injured part must be prepared to replace thin scar which in itself causes contractures and cannot be used to cover deep structure repairs. Combined nerve and tendon injury is frequent and repair should be undertaken as a single project to conserve tissue and time. Current literature on this subject is cited.

Essentials for success in this type of surgery are that the wound heals by primary union, a minimum



Fig. Ventilator fan injury of the right hand. The thenar and hypotenar muscles were severely lacerated, the metacarpophalangeal joint of the thumb was held open, and the ulnar nerve and blood vessels were avulsed with flap. The index and middle fingers were almost completely ruptured at the proximal interphalangeal joints. Immediate cleansing, excision of the ragged and torn tissue, repair of the joint capsule of the thumb, suture of the ulnar nerve, and closure of wound without drainage were done. Left, Immediately after injury. Right, At primary dressing, 6 days later.

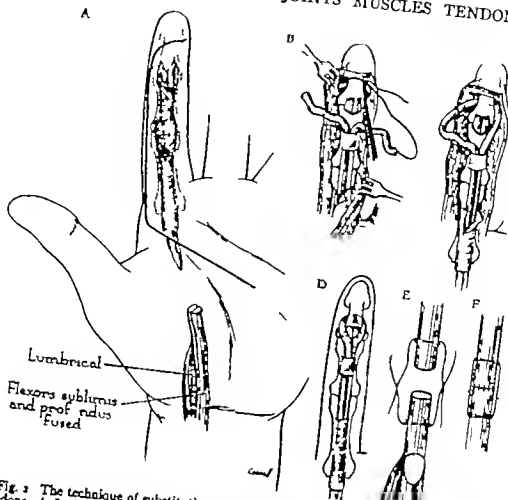


Fig. 3 The technique of substituting a free tendon graft for hopelessly injured flexor tendons. A, Incision. B After the fibrosed flexor tendons have been excised, free grafts are drawn through the carefully preserved tendon sheath and a guide suture is carried around the distal phalanx through a shallow tunnel made with a sharpened aneurysm needle. C, The free ends of the two tendons are smoothly united through the tunnel, and the graft is drawn taut, by tension on the tendon first drawn through the tunnel, and the line of suture comes to lie in the midline on the dorsum of the distal phalanx. D Fine silk sutures between the tendon graft and the stump of the profundus help to make the attachment of the graft to the distal phalanx secure. E, F, Suture of the proximal end of the graft to the proximal segment of the flexor profundus. Incision in the finger is closed before suture of the graft to the profundus is carried out.

of inflammatory reaction to surgery is incurred and that the postoperative wound be kept at rest so that sutured nerves and tendons are relaxed until firm union has taken place.

Incision may be planned to include excision of an old scar and thus avoid multiple scarring. Closure over repaired nerves and tendons must be made by means of a reflected flap so that the skin and subcutaneous tissue continuity remains uninterrupted over the deep suture lines. Such closure aids in preventing adhesions by imitating nature in surrounding the nerves and tendons only with areolar tissue. Foreign material of various sorts has proved to initiate scarring and adhesions and thereby inhibit free gliding on which normal function depends.

Tendon grafts are useful to bridge separations particularly of severed flexor tendons within the digital sheaths and may be taken from the long extensors of the foot uninjured portions of the flexor

sublimis or the palmaris longus. Problems arising in the use of tendon grafts are discussed and the technique used is described and illustrated.

It is best to remove the distal fragment of the flexor profundus and fix the graft directly to the phalanx. To facilitate freedom of movement, the graft is carefully dissected from its bed with an accompanying thin layer of areolar tissue. An adequate incision is used to avoid traumatizing the graft in securing it which reduces the fibrous reaction and subsequent scarring.

The tendon is held in place on the palmar surface of the finger by a part of the digital fibrous sheath or by a new annular ligament made from a free slip of tendon. The degree of tension at which the graft should be sutured to the proximal fragment is difficult to describe but it should approximate that of the normal physiological state this may be obtained by attaching the graft snugly when the wrist

and fingers are maintained in the flexed position. Postoperative immobilization must support the tissues with a minimum of tension at the suture line until firm healing occurs, usually in from three to four weeks. Too early attempts at motion provoke additional inflammatory reaction; therefore gentle active motion is withheld for from two and one half to three weeks. Paralyzed muscles need continued protection against stretching until nerve regeneration is complete in order that the integrity of their function is maintained.

FRANCIS E. BRIDGEMAN, M.D.

Platt, A. D.: Post Traumatic Para Articular Calcifications and Ossifications of the Ankle. *Am J Roent.* 1945 54 348.

Post traumatic calcification of a joint is important and frequently encountered in military personnel. Although calcification of most joints has been described little or no mention has been made of it in the ankle joint.

The etiology and chemistry of para-articular calcifications as well as anatomy of the ankle joint are discussed. In most instances, trauma is the predisposing factor. Immediate roentgen films may reveal only a soft tissue swelling. Serial roentgenograms serve to explain and aid in making a final diagnosis. Within 3 or 4 weeks following the initial injury linear calcification may be seen parallel to the posterior lip of the tibia, the anterior superior tibia, or lateral malleolus. Calcification may be seen also in the interosseous space. There are two types of calcification: evolutive, which appears fuzzy and has hazy margins with varying degrees of opacity in the adjacent connective tissues and stabilised which is a mature contracted, well defined density.

Treatment is conservative: immobilization and physical therapy. Sedation may be employed for pain. In the military services, it is wise to excuse these patients from marching and give them office positions. In severe instances anesthetic injections have been used with good results. Radiation therapy also has been used with favorable results. In most cases, full function of the ankle is never restored, and calcification may persist and be followed by fusion. Although there have been reports of cases of spontaneous regression of calcium, they are very rare.

MAURICE D. SACRE, M.D.

Horn, C. E.: Acute Ischemia of the Anterior Tibial Muscle and the Long Extensor Muscles of the Toes. *J Bone Surg.* 1945 27 615.

The author presents 2 case reports describing a peculiar type of vascular disturbance, a localized ischemia of the anterior tibial muscle and the long extensor muscles of the toes.

The characteristic clinical symptoms and findings are sudden onset of severe pain in the anterior portion of the leg, rapid development of swelling over the anterior fascial compartment, mild to intense erythema and glossiness and slight to complete peroneal nerve involvement.

The histological changes are identical to those occurring in Volkmann's ischemia. The vascular change is a fibrosis of the media, adventitia, and the periarterial tissue of the anterior tibial artery and ensuing occlusion.

The pathogenesis is obscure, but may be explained by repeated overwhelming physiological demands upon the anterior tibial artery for example, during military drill. Because of the anatomical arrangement, the musculature of the anterior fascial compartment is particularly vulnerable to circulatory disturbances. Idiopathic clawfoot may have its origin in insufficiency of the anterior tibial artery with ischemic contracture.

The treatment consists of early block of the lumbar sympathetic ganglia and early complete vertical incision of the anterior fascia crura. Arterectomy advocated by Leriche, should be performed if phlebotomy does not return to the anterior tibial artery. The authors state that Leriche believes that the elevated artery becomes a diseased sympathetic nerve, inducing vasoconstriction in the collateral network. He has demonstrated the increase in the collateral circulation following resection of the diseased artery.

DANIEL H. LEVINTHAL, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Johnson, R. W., Jr., and Lyford, J., III: The Treatment of Benign Giant Cell Tumor in the Lower Third of the Femur by Curettage and "Tele-scaping" the Fragments of Bone. *J Bone Surg.* 1945 27 557.

In 1936 a patient suffered from a giant cell tumor of the femur and had an operation in which one fragment of the femur was telescoped over the other fragment. The original operation met with permanent success and since that time the authors have employed this procedure in a series of 5 similar cases.

Case 1: White female, age 23, in whom this procedure was carried out. The final shortening was $3\frac{1}{4}$ inch.

Case 2: White female, 38 years of age, with a final shortening of 1 inch.

Case 3: White female, age 22, with a final shortening of 3 inches.

Case 4: Colored woman, 28 years of age, with a final shortening of $1\frac{1}{4}$ inches.

Case 5: White woman, 25 years of age, in whom the final shortening was not noted.

The operative procedure consists of exposing the involved area of bone in the distal femur and cutting a window in the thinnest part of the cortex. The tumor is removed by curettage. The cavity is canalized with pure phenol and washed out with alcohol. The remaining cortex is divided and the distal fragment is forced up around the end of the shaft of the bone by telescoping the fragments and filling the cavity with the end of the proximal fragment. No packs or drains are used. A plaster hip

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space is applied. There is shortening of the leg depending upon the size of the cavity.
This method permits removal of the tumor in cases in which the articular cartilages of the knee joint are intact. Good results were obtained in all cases.
RICHARD J. BARNETT, JR., M.D.

FRACTURES AND DISLOCATIONS

Joell, A. P.: Traumatic Diastasis of the Symphysis Pubis by Muscle Action (Myotomoclasia de la sínfisis pública por acción muscular). *Rev Bras Soc Cirurg* Curitiba 1915 6 136

Diastasis of the pubic bone involves injury of the sacroiliac joint. When the separation is not more than 30 mm. there is only rupture of the ligament of the sacroiliac joint, when it is between 40 and 80 mm. there is total rupture of both the anterior and posterior ligaments. Four kinds of possible displacement in diastasis of the pubic symphysis are described—vertical, transverse, sagittal, and mixed. Pure traumatic diastasis of the pubic symphysis is rare. Among 13,000 cases of fracture Taylor saw 73 of fracture of the pelvis and 10 of diastasis of the pubis without fracture. Such cases of diastasis are generally caused by muscle action. The muscles that produce the diastasis are those of the internal region of the thigh with the leg fixed in hyperextension and hyperabduction.

The clinical diagnosis may be suspected in cases with violent contusions especially of the pelvis associated with serious traumatic shock and signs of lesions of the symphysis and sacroiliac joints. Direct roentgenography confirms the diastasis. In cases of descent of the injured side the roentgenogram shows an apparent ascent of the normal side. The spinopubic measurement is important, that is from the spine of the pubis to the anterosuperior iliac spine. This measurement is small on the uninjured side while on the injured side it increases with the degree of the diastasis.

Surgical treatment is rarely indicated as the pelvic treatment is generally gives very good results. Two cases are described. The first was of the descending variety in which the roentgenogram showed apparent ascent on the normal side. Continuous vertical traction was applied to both sides bringing this side down, but with the feet pressing against the foot of the bed, it exercises counter pressure on the other side and pushes the descended limb upward. In the second case instead of continuous contralateral pressure the head of the bed was raised, the left leg flexed and the right leg on the injured side rested against a block at the foot of the bed. The weight of the body as it slid down the inclined plane of the bed acted on the posterior part of the coccyx and pushed the displaced bone upward. Both of the cases are illustrated. (While anatomical restoration was not complete the functional results were excellent.)

AUDREY G. MORGAN, M.D.

Collom, S. A., Jr.: A Comparative Study of 100 Fractures of the Shaft of the Femur in Which One-Half Were Treated with Penicillin. *Ann Surg* 1945 121 773

The author presents 100 consecutive cases of femoral fractures observed in a general hospital in Italy. Uninterrupted treatment was rendered until the patients were evacuated to the United States for rehabilitation. Eighty-two cases were battle casualties and the remainder were accidental injuries. The former before reaching the general hospital had received shock therapy and primary wound treatment, including excision of damaged tissue and immobilization in a splint cast or a Tobruk splint in an average time of 16 1/2 hours after injury. Seventy-five per cent of the compound fractures of the femoral shaft were severely comminuted and involved from 2 to 8 inches of bone. Fifty-one per cent were fractures of the middle third, 29 per cent of the distal third and 20 per cent of the upper third of the femur.

The reparative method of reduction was that of skeletal traction. Tibial traction was reserved for the lower and middle thirds of the femur with Kirschner wire through the distal femoral fragment to control occasional posterior bowing of the lower fragment.

The authors have conveniently divided their cases into four groups.

Group 1 consists of 20 battle casualties treated without wound closure or penicillin of which 17 were penetrating thigh wounds and 3 were of the perforating type. Initial care was rendered within 25 1/2 hours after trauma. Because of definitive treatment of the wounds was not permitted secondary treatment localized abscesses, blood transfusion, and drainage of this group. In 17 cases the average time for wound healing was 8 1/2 weeks. The 3 other cases had healed union with fair alignment and presented poor results. Bony union was obtained in 17 cases.

Group 2 consisted of 50 compound fractures treated by wound closure and penicillin therapy in addition to débridement and fracture alignment. They were subjected to fasciotomy wound closure skin graft (when warranted) and obliteration of dead space to prevent pus pockets. Each patient was kept on penicillin until wound healing was progressing satisfactorily.

Group 2 A. Nine battle casualties which were treated the same as the cases in Group 1 developed severely comminuted, 3 moderately so and 1 was a transverse fracture. Seven casualties had sustained penetrating wounds and 2 perforating wounds. Callus formation was evident in 4 cases after 8 weeks. Skeletal traction was maintained for an average of 8 weeks. The remaining 5 cases presented poor results.

Group 2 B. In this group there were 41 patients. Thirty of these sustained severely comminuted fem

TABLE I RESULTS OF TREATMENT

Group	N. of Cases	Results		
		Good	Fair	Poor
	10		5	5
	9			4
	4	3		
	8	1		

oral fractures, and 8 moderately comminuted femoral fractures. 2 had oblique fractures and 1 had a transverse fracture. Each patient received approximately three million Oxford units of penicillin either before or upon entrance to the hospital. Twelve hours had elapsed before initial surgery was done. Reparative surgery was instituted 9 days after the injury. The soft parts healed in 4 or 5 days. Callus was noted in 5 weeks and bony union ensued after 11 weeks. Good results were obtained in 38 cases.

Group 3 consisted of 12 cases in which wound closure was performed by the authors without the use of penicillin. In addition to the general treatment, there was delayed primary closure without drainage in this small group. Initial surgery was performed in 13 hours and reparative surgery in 6 days. Callus formation was noted in 6 weeks and firm bony union in 10 weeks. Good results occurred in 11 cases and a fair result in 1 case.

Group 4 consisted of 18 simple femoral fractures, 4 of which did not respond to skeletal traction. These were subjected to open reduction, proper alignment being maintained with metal plates. The results were rated as good in all of the cases.

In conclusion the author maintains that penicillin and blood are of paramount importance in the prevention of sepsis and local infection. If however adequate preliminary surgery is not performed they alone are not a panacea. Reparative surgery of the soft tissues consisting of secondary débridement and closure instituted between the fifth and tenth days, enhances wound healing. The author also believes that the majority of femoral fractures can be treated by skeletal traction when indicated he recommends open reduction of simple as well as of compound fractures.

SAMUEL L. GOVERNALE, M.D.

Sorondo, J. P., and Ferrá, R. L.: *Knee; Fracture of the External Tuberosity of the Tibia (Rodilla fractura de la tuberosidad externa de la tibia)*. *Rev. Is. méd. argent.* 1945 59: 1-57.

Fracture of the lateral tuberosity of the tibia is caused by a violent valgus deviation of the knee generally accompanied by torsion while the knee is in extension and slight flexion. The chief fracture line is directed outward, downward and forward. There may be secondary fracture lines.

The symptoms are pain at the site of the fracture, loss of function, swelling, hemarthrosis, and ex-

cessive lateral mobility. The roentgenogram shows the fracture line and fragments. The internal fragments may not be visible because they are made up of joint cartilage. Surgical treatment is indicated in all cases in which the joint surface is involved. The operative technique is described in detail and illustrated with photographs and roentgenograms. Absolute asepsis is necessary. Ordinary surgical asepsis is not sufficient. The fragments must be kept in place by some foreign material, such as a nail, a screw or a bolt with a nut on each end. A plaster cast is kept on for 2 or 3 months, after which massage and active and passive mobilization of the knee is begun. After 3 or 4 months the patient may sail with a cane if the x-rays show solid bone callus.

Within the past 25 years the author has operated on 8 cases. The late results cannot be reported because the time has been too short but the early results show that the disadvantages of operative as compared with nonoperative treatment are the danger of infection, and necrosis of the fragments. These can be prevented by the strictest asepsis. The advantage of operative treatment is better reduction. There is no danger of postoperative rigidity as the internal lateral ligament and the cruciate ligaments are generally loosened by the trauma which caused the fracture. This causes a certain degree of lateral instability of the knee but, on the other hand, it favors mobilization when the cast is removed.

ALBERT G. MORGAN, M.D.

ORTHOPEDICS IN GENERAL

Woolley P. V., Jr., and McCammon R. W.: *Bone Growth in Congenital Myxedema*. *J. Pediatr. S. Louis*, 1945 7: 19.

The authors state that the chronologic appearance of ossification centers is a useful index to thyroid function in infancy but is too slow for use in the control of therapy in the young cretin. Normal linear bone growth is suspended in the absence of thyroxine, and roentgenologically visible changes occur within three weeks of the beginning of the administration of thyroid extract. A curve of the normal growth rate of the radius during the first two years of life is used as a standard for comparison. With the radial growth rate in cretins before and during the administration of thyroid extract. Dense calcification at the epiphyseal plate, absence of carpal bones, and short radii are the roentgenologically recognizable stigmata of cretinism which are apparent before the clinical picture is clear-cut.

The findings in 3 patients from 2 to 4½ months of age are described and in 2 cases correlated with x-rays of radial growth resumption during thyroxine extract therapy. Radial growth in these cases is initially more rapid than the established norm, but levels off once the average growth is attained. New bone forms distal to the densely calcified bone near which is gradually replaced and disappears.

This information provides a means of accurately regulating the thyroid treatment of cretin by

monthly x ray studies, and of establishing the diagnosis of cretinism in infants under 2 years of age

FRANCIS E. BRENNICK, M.D.

Berman J. K.: Intercapulothoracic Disarticulation of the Arm. *Surgery* 1945 18 356

Intercapulothoracic disarticulation means the removal of the entire arm and shoulder. This includes the scapula, the outer two-thirds of the clavicle and all attached muscles and fasciae.

The disarticulation permits the complete excision of all anatomic lymphatics and lymph nodes all related muscular and fascial planes and all involved axillary tissue together with the related bones. This may be done as a unit operation with less blood loss than in a radical mastectomy. The skin flaps are usually adequate so that skin grafts are ordinarily unnecessary.

The mortality rate of this radical operation is no greater than for ordinary amputations of the upper arm. Therefore aside from the disfigurement and inconvenience produced there are no objections to its use. Certainly these are inconsequential objections when compared with the additional chances for cure. If a portion of the arm must be removed then the inconvenience is not much greater and the

disfigurement though unsightly may be rectified by proper shoulder pads.

The author defines the indications for the procedure describes its technique and calls attention to the importance of this old operation under modern diagnostic and surgical methods. Photographs and anatomical drawings photoroentgenographs and photomicrographs are presented. Five cases without operative mortality are reported. The operation may be safely done at any age. Soft tissue growths gave better results than lesions in bone. The former found in older patients were carcinomas.

The value of preoperative roentgen therapy has not been determined but roentgen therapy is advised because it may lessen the chance for metastasis and local recurrence. It may reduce the size of radio-sensitive or infected growths and thereby facilitate complete extirpation.

None of the patients had local recurrences. The 3 deaths occurred from internal metastases. They all occurred in patients with sarcoma.

The end-results of intercapulothoracic disarticulation are encouraging. Available statistics though meager prove that the operation offers a chance for cure in cases ordinarily considered hopeless.

ROBERT P. MONTGOMERY, M.D.

SURGERY OF THE BLOOD AND LYMPH SYSTEMS

BLOOD VESSELS

Freeman, N. E.: Secondary Hemorrhage Arising from Gunshot Wounds of the Peripheral Blood Vessels. *Ann. Surg.* 1945 21 631.

Secondary hemorrhage following gunshot wounds in the first world war was a common complication. Although present methods of débridement, immobilization, and chemotherapy have resulted in a striking reduction in the frequency of this complication, the occasional occurrence of severe bleeding often with disastrous consequences, still make this problem an important one. The author arrives at the following conclusions insofar as his experience was concerned.

The incidence of secondary hemorrhage in 2,163 cases of gunshot wounds of the neck and extremities was 2.06 per cent. Of the 23 patients, 15 bled from wounds of major blood vessels. The present study is based on an analysis of these 15 cases.

Laceration of the arterial wall, rather than complete severance, was found in the 23 patients whose wounds were explored. There were 3 deaths in the group. Two patients developed gas gangrene and 1 of these died. Ligation of the femoral artery resulted in ischemic gangrene requiring amputation in 1 case. Recovery took place in the remaining patients.

A history of severe or recurrent hemorrhage in the forward area, or the presence of severe anemia on admission, is indicative of injury to a large blood vessel. Secondary hemorrhage is to be anticipated in cases with these findings. In spite of a demonstrated large opening in the main artery of the extremity the peripheral pulse was normal in 6 cases, reduced in 2 and absent in only 1 patient. Periarterial hematoma was found in 4 individuals, but pulsation and bruit was present in only 2 of these. Peripheral edema or diminished sensation in the distal parts of the extremities was present in three-quarters of the cases with lacerations of the blood vessels of the extremities.

One case of rupture of an arteriovenous aneurysm of the neck is reported. In a second case of secondary hemorrhage from the neck, the bleeding, which was definitely venous in origin, was controlled by suture of the tissues over the bleeding point. Both patients recovered.

In all patients the major artery was exposed by wide extension of the original wound. Suture of the arterial laceration was attempted on 2 occasions. It was apparently successful in 1 case. In the second case thrombosis at the suture line extended downward and contributed to the development of gangrene. In the remaining patients the artery was divided and ligated with No. 1 chromic catgut. No untoward results were observed after the use of this absorbable suture material.

The injection of alcohol into the region of the paravertebral sympathetic ganglia was performed in 4 cases with good results. In a fifth patient, procaine was repeatedly injected.

A small initial hemorrhage occurred in 7 patients before the severe blood loss which prompted operation. Attention is again called to this "red signal" as an "inexorable indication for exploration of the wound."

PAUL MEXNER, M.D.

Eaton, R. M., Czebrinski, E. W., and Smith, J. R.: Observations on Pulmonary Arterial Pressure and Peripheral Venous Pressure Following Arterial Blood Loss. *J. Thorac. Surg.* 1945 10 339.

This contribution represents the first of a series of studies concerned with pulmonary and circulatory changes resulting from simple peripheral arterial blood loss. During experimental studies by the authors on pulmonary lymph flow in which controlled arterial bleeding was instituted, very consistent lung changes, which were almost starting in their apparent import, were observed quite accidentally. Pulmonary edema and pulmonary hemorrhage were produced at will by the simple removal of moderate to large quantities of blood from the femoral artery the greater the blood loss, the greater the pulmonary damage. Inasmuch as great loss of blood is such a common occurrence on the battlefields of the world, a study of the physiological factors involved in this pulmonary change seems necessary.

The authors first report the results of their experiments with a large group of dogs in which 25 per cent of the blood volume was removed, for it was thought that the loss of this quantity would simulate a battle casualty. A second series of experiments with 20 per cent loss of blood volume was made to compare with an operative hemorrhage of about 300 cc. in an average human being. The methods of study are described in detail and the results are discussed at some length.

It would seem possible that the pulmonary congestion resulting from systemic arterial blood loss is the result of increased permeability of the alveolar endothelium, due to acute anoxia of the tissues. When the physiological events are reconstructed, as acute anoxia is apparent for many reasons. Breathing is noted to be rapid, deep and forced air hunger has been produced and carbon dioxide concentration is increased. With arterial hemorrhage, there is a true loss of blood volume and a decrease in available red corpuscles to carry oxygen. The heart rate increases in hemorrhage but cardiac output actually decreases. There is evidence that the circulation time is greater and that vasodilatation occurs. Besides these factors, there are certain experimental observations which show that deep, rapid, forced

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respirations and anoxia can produce increased pulmonary transudation.

Pulmonary congestion resulting from acute arterial blood loss produces a block to normal circulation and an increase of pressure within the peripheral venous system, as well as within the pulmonary artery. This pressure is developed within the vessel its peak in from 50 to 60 minutes from the time of hemorrhage.

The observations presented here are consistent with those of the anatomic and clinical findings about "bomb blast lung," a pathological condition brought about by instantaneous overdistention of the alveoli most typical lesion of bomb blast injury to the chest wall. The rage and edema of the lungs and there is homoevidence of high venous pressures. Proof of this fact might make it desirable to try venesection as a life-saving procedure, as in the pulmonary edema of congestive heart failure.

The authors conclude that there is a gradual decline of these elevated venous pressures to a lower than normal level within 144 hours of the hemorrhage. Increased venous pressure during intravenous administration has been shown experimentally to elevate the venous pressure additionally.

HENRIET F. THURGOOD M.D.
NELSON, J. J.: Universal Vascular Compressor for the Development of Collateral Blood Circulation in Arterial and Arteriovenous Aneurysms. *U S Aev M Bul* 1945 45 1169

The use of modern firearms has led to an increase in blood vessel injuries and arterial and arteriovenous aneurysms. Since spontaneous recovery of these conditions is so rare, surgical operation is the only indicated means of treatment. The time of surgical interference is a controversial point. Some surgeons regard the second and third week after injury as the ideal time to operate, while others wait as long as three months.

Complete momentary ligation with sympathetic omy (Käther) incomplete ligation (Hilalated Mats, Allen) the operation of Eklital Sym (ligature inside the sac) the operation of Mats (obliterative or reconstructive) and vascular sutures for the preservation of vessel lumen have all been suggested for the treatment of arterial aneurysms and arteriovenous aneurysms.

Since pathological changes occur in the vessel walls, ligation of the blood vessel accompanied by dissection of the sac seems to be the preferred operation today. The operation is technically simple and practical regardless of pathologically simple and changes in the vessel walls. The danger of limb necrosis after ligation of the main arterial trunk is real as to percent of the cases in World War I showed this complication.

Surgeons have been working on the problem of preventing gangrene of the limbs after arterial ligation to decrease the number of amputations. Not

all arteries are equally affected. Ligation of the popliteal artery is particularly hazardous. Nearly 20 per cent of the ligations of the carotid artery threaten the patient with serious circulatory disturbances of the brain.

All surgeons agree that the necessity of primary development of a collateral circulation is of primary importance. Rather advocates sympathetic section, contrast baths and diathermy to improve the collateral circulation.

Mechanical compression of the arterial trunks is accomplished in most institutions with digital pressure by a doctor or nurse. This is tiring and practically of no value. It is not practical when several patients in the same ward suffer from aneurysms if the compression is entrusted to the patient it is usually not effective.

A vessel compressor has been devised to obviate these difficulties. Compression of the vessel is effected by a screw rod fastened in a block at the required angle by a globular nut. This block moves along the grooves of the upper arm of the clamp. The hand wheel can be removed when the desired degree of compression has been established so the patient cannot alter the pressure himself.

A constant or removable plaster bandage in which the clamp is fixed is applied to the patient. Compression of the common carotid is effected approximately at the level of the Chassaignac tubercle between the ends of the sternocleidomastoid muscle. The patient is kept recumbent with the head slightly elevated on a pillow.

Subclavian compression is effected between the clavicle and the upper part of the sternocleidomastoid muscle and the upper side of the clavicle. The patient should be recumbent with the head slightly elevated beneath Poupart's ligament, above the femoral artery. Compression of the femoral artery is effected just part of the pubis. The patient should be placed recumbent.

At first the compression is applied several times a day for from 10 to 15 minutes each time. Then for the subclavian and femoral arteries, compression may be applied for from 2 to 3 hours several times a day during the next week. For the common carotid great caution must be practiced at the beginning of the compression should be applied for only 10 to 15 minutes at a time. Careful watch must be kept for paresis or paralysis and other symptoms of circulatory disorders.

Just how a patient will react to carotid pressure never can be predicted, and a case is presented to show the possibility of a dangerous reaction. Other cases such as this primary ligature certainly would cause a serious circulatory disturbance in the brain. Other wounded patients bear common carotid pressure well and soon the artery can be compressed for long periods without unpleasant consequences or circulatory disturbances. One cannot guess in which cases compression of the common carotid for a long

time is safe. This can be ascertained only by careful observation at the time of compression.

In the course of compression the limbs may become cyanotic from proximal vein pressure. This is without dangerous after effects and may be counteracted by massage and warming. Carotid pressure may cause coughing from simultaneous vagus nerve pressure. If applied for a short time, compression does not cause painful sensations. If after 2 or 3 hours pain develops, it responds well to small doses of narcotics.

After the apparatus has been used it can be disassembled and the parts cleaned with alcohol and packed away. The block, groove, and globular unit must receive particular care. The clamp is left cemented in plaster but its groove must be cleaned well with alcohol.

To check the efficiency of compression, a sphygmographic record of the arteries, such as the common carotid or subclavian, may be made or digital palpation of the distal vessels carried out.

One patient completely recovered from an arteriovenous aneurysm after prolonged application of the compressor to the right subclavian artery. His case is reported.

In order to develop the collateral circulation, one must compress a single arterial trunk without disturbing the collateral paths.

Mistak vessel compressor is unfit for compression of the femoral artery immediately under Poupart's ligament, as well as of the subclavian or carotid arteries. The proposed vessel compressor allows compression of nearly all the large arterial trunks such as the common carotid, subclavian, and femoral arteries, but it cannot be used for direct compression of the iliac artery. When this vessel requires ligation the application of pressure to the femoral artery high under Poupart's ligament is recommended.

ROBERT R. BRIDLOW, M.D.

Whipple, A. O.: The Problem of Portal Hypertension in Relation to the Hepatosplenopathies. *Ann Surg* 1945 133 449.

This contribution is based upon experience and studies gained from the organization of the Spleen Clinic at the Columbia Presbyterian Medical Center in New York. In order to elucidate the pathogenesis, pathology, diagnosis and treatment of portal hypertension certain points in the anatomy and physiology of the circulation of the liver and spleen are reviewed in detail.

The amount of portal bed obstruction, and the type and site of obstruction are all variable factors in individual patients with portal hypertension. It is the discovery in the individual patient of these factors and their analysis that very largely determines the diagnosis, treatment and prognosis. Patients with portal hypertension may be divided into two main groups: group I, those having intrahepatic portal block, and group II, those having extrahepatic portal block. In the first group the cirrhotic, especially of the portal or Laennec type

are associated with portal block. The mutual influence of the portal and arterial pressures within the liver provides an important explanation for the rise of portal pressure in portal cirrhotics, and also explains the variability of portal hypertension in the cirrhotics and the presence or absence of gastrointestinal hemorrhage as an accompaniment of portal hypertension.

With regard to group II there are two types of obstruction seen in chronic occlusion of the portal vein and its main tributaries. The first is a replacement of the vein or its main tributaries with fibrous tissue with little or no canalization. The second is a transformation of the portal vein, its main tributaries, or the enveloping tissue into a cavernomatous mass of small tortuous vessels, a process spoken of as cavernomatous transformation of the portal vein. In the first type of fibrous replacement there are two causative factors. The most common is an organization into scar tissue of a thrombosis of the portal vein. The thrombosis may be the result of inflammation, trauma, or pressure from without by inflammatory or neoplastic tissue. The second causative factor is an extension into the left portal vein, or proximal to it into the main portal vein, of the obliterative fibrotic process that takes place at birth in the umbilical vein and ductus venosus as they empty into the left portal vein. This type of obstruction is rare but is seen in young children that begin at an early age to show portal block with splenomegaly and a Banti syndrome. The pathogenesis of cavernomatous transformation is not definitely known but it would seem logical that the etiology of this lesion is a variable one.

The collateral circulation in portal block has been classified as of two types, the "hepatopetal" and the hepatofugal. When the circulation through the liver is unobstructed and the block is limited to the portal vein the blood may be shunted through the hepatopetal collateral veins into the liver. In lesions causing intrahepatic block the hepatopetal circulation shunts a variable amount of blood from the gastrointestinal tract and spleen around the liver.

Both chronic intrahepatic block and extrahepatic portal block have been successfully produced in experimental animals. In the experimental animals and in many of the patients, portal bed block produces a fairly typical syndrome. This is true of the cases showing a splenomegaly whether the block is intrahepatic or extrahepatic. This syndrome consists of a variable secondary anemia, a leucopenia, a thrombocytopenia, a splenomegaly, and a tendency toward repeated severe gastrointestinal hemorrhage, most frequently associated with ruptured esophageal varices. The liver may be cirrhotic or normal, according to the site of the portal bed obstruction. This syndrome is frequently spoken of as Banti's syndrome. It is the author's present concept that Banti's syndrome is the result of mechanical obstruction to the flow of blood within the portal bed. In the cirrhotics there is a variable amount of portal

hypertension, determined by the amount of scar tissue in Glisson's capsule the relation of the pressure in the hepatic artery to that in the portal vein, and the extent of the hepatofugal circulation. For these reasons splenomegaly gastrointestinal hemorrhage, leucopenia, and thrombocytopenia are not always found in the cirrhotics. This syndrome is not characteristic of the biliary and cardiac cirrhotics. On the other hand if the extrahepatic portal block, from whatever cause, is sufficient to produce splenomegaly Banti's syndrome is nearly always present, and a normal liver is usually found even in the cases of long standing.

Patients with portal hypertension great enough to cause an enlarged spleen usually present leucopenia, thrombocytopenia, and secondary anemia of Banti's syndrome. There may be no history of gross gastrointestinal hemorrhage. The differential diagnosis from other splenomegalies is largely determined by accurate hematological studies. The site of portal block, as to whether it is intrahepatic or extrahepatic, can usually be determined by certain liver function tests. If the liver function tests are negative it is safe to assume that the block is extrahepatic. This does not determine the site of the extrahepatic block, although the history or the age of the patient may indicate it. The author has been unable to determine the site of extrahepatic block at the time of splenectomy in more than half of his patients although recently he has been able to demonstrate the block by diodrast venograms and roentgenograms made during the operation at the time of determining the portal vein pressures.

The therapy of portal bed block, both intrahepatic and extrahepatic, associated with Banti's syndrome is considered in the discussion of treatment. Three factors, the site of the block, the degree of portal hypertension, and the extent and competency of the collateral circulation determine the use of the spleen and the incidence of gastrointestinal bleeding. The two latter components of the syndrome are the usual indications for attempted surgical therapy. In the past, three lines of surgical attack have been followed: splenectomy, the establishment of a collateral circulation with omentopexy and the ligation of tributaries to the esophageal varices. If the portal block is in the esophageal vein the removal of the spleen results in a permanent disappearance of the Banti's syndrome. Unfortunately this site in the splenic vein is not common one for portal bed block. However even with the block in the main portal vein splenectomy provides relief for a variable time because of the removal of a large area of the portal bed and until the portal hypertension builds up again. The efficacy of omentopexy is questionable. If the operation is done in the presence of a well established collateral venous circulation in the abdominal wall the results in a few cases are encouraging but are probably due to Nature's efforts rather than to the surgeon's. Attempts to ligate the tributaries feeding into the veins of the cardia and esophageal varices

have been disappointing. Injection and coagulation methods to obliterate the esophageal varices have produced no improvement, since these methods shut off one of the chief collaterals between the portal and systemic circulation and increase the portal hypertension. The large number of patients with portal vein block and Banti's syndrome who had portocaval anastomosis but who continued to have recurrent gastrointestinal hemorrhage challenged the members of the Splenic Clinic to seek a more effective and permanent therapy.

Efforts to anastomose branches of the mesenteric veins to the spermatic, the ovarian, and the inferior vena cava by suture technique failed. When Blake and Lord developed the endothelial lined vitallium tube nonsuture technique for bridging large vessel defects it was decided to apply this method to portocaval anastomosis. With this principle, 10 of these major operations have been carried out, 5 by union of the splenic vein and left renal veins after removal of the spleen and left kidney. In the last 5 patients the portal vein was anastomosed to the inferior vena cava, end to side. All the patients have survived their operations. The results in 5 have shown such improvement that the application of portocaval anastomosis by the nonsuture technique is being extended to the nonfollow up period of at least three years to determine the value of these procedures.

JOHN L. LINQUIST, M.D.

Blakemore, A. H. and Lord, J. W. Jr. The Technique of Using Vitallium Tubes in Establishing Portocaval Shunts for Portal Hypertension. *Ann. Surg.* 1945 122: 476.

Since Eck first performed successful experimental anastomosis of the portal vein to the vena cava surgeons have been interested in the clinical application of the Eck fistula for the relief of portal hypertension. The rare reported instances of portal hypertension and the discouraging results of attempts at the establishment of portocaval shunts by suture and the discouraging results signify the technical obstacles to its clinical application. The development of the vitallium tube nonsuture method of accomplishing either splenorenal anastomosis or portocaval anastomosis has afforded a new method of accomplishing either splenorenal anastomosis or portocaval anastomosis. Splenorenal anastomosis is capable of handling a large volume of blood and has the peculiar advantage of eliminating a sizable portion (estimated at 40 per cent) of the total circulating portal blood volume by splenectomy. The authors' clinical experience thus far has been limited to end to end anastomosis of the splenic vein to the left renal vein. The facility with which an end to side anastomosis may be carried out with a vitallium tube anastomosis alternate method to the sacrifice of a kidney. The technique consists of mobilizing the spleen and preserving the full length of the splenic vein with minimum trauma during splenectomy. The splenic artery is ligated and the spleen is somewhat emptied of its blood. The splenic vein is ligated just at its

primary distal branching. The blood is then milked far proximalward in the vein and a rubber-shod clamp applied. Following removal of the spleen the stump of the splenic vein is opened, triangulated with clamps, and irrigated with normal saline solution.

The left kidney is removed, but a maximum length of the main renal vein is preserved for the anastomosis, and a rubber shod clamp is applied as far proximally as possible. The stump of the renal vein is treated in the same way as the stump of the splenic vein and a proper sized vitallium tube is selected. The end of the splenic vein is passed through the tube, triangulated and everted over the end of the tube. The vein is held in place by a ligature of silk placed behind a ridge on the tube. The intima covered end of the vitallium tube is introduced into the renal vein and a ligature is applied over the vein proximal to the ridge on the tube. A second ligature is used to approximate the renal vein snugly to the splenic vein near the end of the tube. The latter ligature prevents blood from penetrating between the two intimas. The clamp on the splenic vein is released and immediately following the clamp on the renal vein is released. It was necessary to resort to a vein graft in only 1 of the 5 cases.

The Eck fistula type of portacaval shunt has the advantage of size. An end to end anastomosis of the portal vein to the vena cava by the nonsuture vitallium tube technique affords an estimated blood carrying capacity from 30 to 40 per cent greater than a splenorenal anastomosis. In order to avoid the undesirable use of a vein graft it is necessary to mobilize the portal vein from its bifurcation at the liver to the origin of the splenic vein. The portal vein is mobilized, to protect the common duct and hepatic artery from injury and a rubber shod clamp is applied to the portal vein at the origin of the splenic vein. A transfusion ligature is placed around the portal vein at its bifurcation close to the liver, and the vein is transected distal to the ligature. The vena cava is mobilized from the level of the liver down past the entrance of the left renal vein to the upper level of the right renal vein and a clamp is placed but not tightened at this time. The portal vein is passed through a vitallium tube and cuffed over the end of the tube and ligated behind the holding ridge. The vein covered vitallium tube is now swung out from behind the common duct and over the vena cava, and a site for the anastomosis which will not result in angulation or compression of the vein is selected. Two purse string sutures of silk are introduced into the full thickness about the site chosen for anastomosis to form two circles the diameters of which are 4 and 6 mm. larger respectively than the diameter of the vitallium tube. A second clamp is placed at the upper part of the mobilized vena cava and the distal clamp is tightened to occlude the vena cava. A cruciate incision is made through the vena cava wall and the apex of each quadrant grasped with mosquito forceps. The veins are irrigated with

saline solution and the vitallium tube bearing the portal vein is advanced into the opening. The inner purse string suture is tied proximal to the ridge on the tube. To establish the blood flow the proximal clamp on the vena cava is released first, followed immediately by release of the clamps on the portal vein and the distal vena cava, respectively.

This article is based upon experience gained in the establishment of portacaval shunts in 10 cases (5 splenorenal anastomoses, and 5 portal vein to vena cava anastomoses). Convincing clinical evidence of portal hypertension should be procurable in the vast majority of cases preoperatively. One can accurately predict on the basis of liver function chemistry whether portal hypertension is due to intrahepatic (portal cirrhosis) or extrahepatic portal bed block. The variable origin of the coronary vein from the splenic or portal vein accounts for the presence or absence, respectively, of esophageal varices in congestive splenomegaly due to a block in the splenic vein.

Splenectomy alone as a treatment for congestive splenomegaly should be limited to those cases of splenic vein thrombosis in which the coronary vein arises from the portal vein, or if it arises from the splenic vein, to those cases in which the obstruction is distal to its origin. At operation in cases of congestive splenomegaly due to extrahepatic portal block, venous pressure readings are essential to determine the obstruction sites in the splenic vein. A normal reading from a branch of the superior mesenteric vein and an elevated reading from a branch of the coronary vein of the stomach would indicate a block in the splenic vein and suggest that the coronary vein originates from the splenic vein distal to the site of the obstruction. This evidence would make splenectomy followed by splenorenal anastomosis preferable to splenectomy alone. In a case of congestive splenomegaly in which the superior mesenteric pressure is normal, the splenic venous pressure elevated but the coronary vein pressure approximately normal, a splenectomy alone would be indicated. Venography following injection of diiodol in a branch of the coronary vein is useful in confirming the site of origin of the coronary vein. In most cases of cavernomatous transformation of the portal vein splenorenal anastomosis is likely to be the only type of portacaval shunt it is practical to use. It was found feasible in 1 case of atresia at the portal fissure in which the spleen had been previously removed to do a portal to vena cava anastomosis with a vein graft.

Every one of the 10 cases of portacaval shunts went through a successful postoperative convalescence. The interval following operation has been too short in some to judge the results. However, in 6 of the 10 cases the improvement has been so outstanding that it justifies continuation of the procedure. The Eck fistula operation is better tolerated by the patient, in all probability because of less blood loss during the procedure.

JOHN L. LINDQVIST, M.D.

SURGERY OF THE BLOOD AND LYMPH SYSTEMS

LYMPH GLANDS AND LYMPHATIC VESSELS
David, P.: Hodgkin's disease (La maladie de Hodgkin)
Union med. Canada, 1945 74 1543

The author presents a table showing the details of his findings in a careful study of 30 cases of Hodgkin's disease. Jackson and Parker have described three types of Hodgkin's disease: Hodgkin's granuloma, Hodgkin's sarcoma, and Hodgkin's lymphoma. The prognosis in these conditions depends on the type of the lesions. If this classification should prove valid it is a very important contribution to the subject.

Neither Sternberg nor Reed discovered the cells which bear their names. The frequency of the disease increases with age. It is as yet impossible to say whether Hodgkin's disease is infectious or non-infectious. It is a borderline disease which makes it especially important. Gordon thought he had discovered a virus for it but was unable to prove it. Nevertheless his test is of some value. Poston discovered brucella melitensis in 14 consecutive cases and this may prove to be the causative agent. Prunius is a secondary symptom which is not very frequent. The author has seen three types of fever: it may be impossible to make a diagnosis of abdominal Hodgkin's disease.

There is no typical blood picture in the disease but yet the blood picture may be an aid in diagnosis. Eosinophilia is rare. Even if the clinical picture is very severe roentgen ray or radium treatment should be given. In selected cases surgical extirpation of the glands followed by roentgen or radium therapy has given very good survivals. Any visible hypertrophy of the glands should be examined at once by means of biopsy. The longest survivals have been seen in the cases of early removal of Hodgkin's glands.

AUDREY G. MORGAN, M.D.

Cherische, H.: Tumors in One of Homologous Twins; Hodgkin's Disease with Primary Skeletal Manifestations. *Am J Roent* 1945 54 479.

The author reports the fifth case of Hodgkin's disease in one of homologous twins. The first 2 cases in the literature were reported by the same author. The patient was a white female aged 5 years one right hip and right shoulder fever and loss of weight of ten weeks duration. On examination, aside from poor nutrition fever increase in the pulse and respiratory rates and leukocytosis manifestations of the disease were limited to the roentgen



Fig. 1. Hodgkin's disease in one of homologous twins (Healthy twin refused to take off shoes.)

findings of areas of rarefaction in the parietal region of the skull, the right clavicle, and the right ilium. Roentgen therapy to the right hip and clavicle was of no benefit and the child died one month after admission shortly after the onset of a bilateral pneumonia. Postmortem examination revealed Hodgkin's disease of the thymus cervical lymph nodes liver spleen bones and lungs with secondary emphysema and bilateral pneumonia. The patient a homologous twin was last examined four years and eight months after the onset of symptoms in the deceased homologous twin. Physical examination, including roentgenographic study of her skeleton and lungs showed no evidence of any pathological condition. EMMETT E. ARNHEIM, M.D.

SURGICAL TECHNIQUE

OPERATIVE SURGERY AND TECHNIQUE POSTOPERATIVE TREATMENT

Lovell, D. L.: Skin Bacteria; Their Role in Contamination and Infection of Wounds. *Arch. Surg.* 94:5 51-78.

Investigations were carried out to determine the type and number of bacteria gaining entrance to the wound during the course of routine operation and their role in the infection of the wound.

To determine the number and type of organisms gaining entrance to the wound during operation cultures were taken as follows:

1. After proper skin preparation a sterile sponge, thoroughly moistened with isotonic solution of sodium chloride was rubbed over the skin. The saline solution was then expressed from the sponge into a sterile container. All this solution was cultured by the pour plate method. After 24 hours of incubation, the number and type of colonies present were recorded.

2. Immediately after the incision in the skin had been made, towels were clipped to the edges to prevent, so far as possible, surface bacteria from getting into the wound. The wound was then irrigated with a small amount of isotonic solution of sodium chloride and the solution cultured by the method previously mentioned.

3. After the primary object of the operation had been accomplished the wound was again irrigated and the solution cultured.

4. After the wound had been closed the towels were removed, and the final culture was made from the surface of the skin.

Although there is no accurate method of recovering all the organisms in the wound or on the surface of the skin, the procedures used gave uniform results which were satisfactory for comparison. All operations were performed under bactericidal radiant energy to minimize contamination from the air.

Cultures were taken during 35 operations for inguinal hernia and during 115 operations of other types. Few organisms were obtained from the surface of the skin immediately after mechanical and chemical cleansing. Some of the cultures were sterile, but of those which grew organisms the greater number presented the staphylococcus albus. Other bacteria, including the staphylococcus aureus, the escherichia coli, and a nonpathogenic fungus, were present occasionally in small numbers.

In the second culture, it was shown that in most instances a few organisms were carried into the wound with the skin knife. They were of the same variety as those obtained from the surface of the skin were relatively nonpathogenic, and belonged to the resident flora.

The number of organisms obtained from the wound just before closure was considerably greater

than the numbers recovered in the first two cultures. This was probably due to the fact that the bacteria which gained entrance to the wound multiplied during the time of operation.

A large number of organisms were obtained from the surface of the skin after closure of the wound. This was thought to be due to the resident flora rising to the surface and multiplying during the time of operation.

The number and type of bacteria obtained from the surface of the skin immediately after mechanical and chemical cleansing did not vary greatly with the character or location of the operation. The number of bacteria removed from the wound before closure was greater in the operation for inguinal hernia than in the other operations. This was thought to be due to the presence of numerous hair follicles in this region which results in a larger resident flora.

During operations the skin should be considered contaminated at all times regardless of the preoperative preparation. In closing the wound the towels should be left in place until the wound is closed in the subcutaneous fascia. At this time the surface of the skin should be considered much more contaminated than at the time the original incision in the skin was made. The towels should then be removed, the surface of the skin cleansed with the antiseptic solution, and clean sterile towels placed over the area before the sutures are inserted in the skin. Stitch abscesses are best avoided by the additional precautions of early removal of the suture and the avoidance of tension. LUTHER J. FROST, M.D.

Starr, I., Mayock, R. L. and Battles, M. C.: Convalescence from Surgical Procedures. Studies of Various Physiological Responses to a Mild Exercise Test. *Am. J. Hyg.* 94:5 1-77.

The aim of the authors' investigation was to explore the possibilities of finding objective methods of demonstrating abnormalities present in convalescence after surgical procedures which would serve as an indication of the duration of the convalescent state and as a test of measures designed to shorten it. The authors believed that no abnormalities characteristic of convalescence would be demonstrable while the patients lay at rest, but they hoped that when the patients performed a task, abnormalities might manifest themselves. For this purpose a easy weight lifting test was devised which could be performed by the subject while lying in bed on his back and breathing from a spirometer designed to measure the basal metabolic rate. By this means oxygen consumption could be determined without gas analysis and both the rate and volume of respiration estimated from the spirometer record as well.

Oxygen consumption and volume, and the rate of respiration were determined before, during, and after standard exercise. The cardiac output (balistocardi-

diagram) and pulse rate were estimated before just after and 5 minutes after the same exercise. Measurement of the magnitude of the changes induced by the exercise revealed no significant differences which could be attributed to convalescence. However when attention was given to the duration of the changes induced by the exercise the increased oxygen consumption, respiration, and pulse rate declining to the resting level more slowly during convalescence than before operation.

The respiration and oxygen consumption of subjects at rest were not significantly changed during convalescence. The variability in the physiological response to exercise is so great that a test of the type used gives no promise of providing a satisfactory measure of the duration of convalescence in individual cases. However, the slow return to normal of the pulse rate, respiration, and oxygen consumption after exercise may have some value as an indication of persisting abnormality in certain individuals and will provide significant differences when data obtained from a series of 10 or more cases are averaged.

JOSEPH K. NABAR M.D.

Enklins J. P.: The Effect of Postoperative Exercises and Massage on the Incidence of Pulmonary Embolism at the Chelsea Hospital for Women. *J. Obst. Gyn. Brit. Empire* 1945 52 480.

Postoperative exercises and massage were introduced at the Chelsea Hospital for Women in 1937 in an attempt to reduce the incidence of pulmonary embolism.

The incidence of fatal embolism following abdominal operations fell by more than 50 per cent in the subsequent 7 year period.

The deaths from embolism are reviewed with regard to general incidence, age of the patient, and type of operation. Some details of the exercises and massage employed are given and are followed by a short discussion with references to the recent literature.

JOHN J. MALOYER M.D.

ANTISEPTIC SURGERY TREATMENT OF WOUNDS AND INFECTIONS

Evans, E. I. and Bligden J. A.: The Rationale of Whole Blood Therapy in Severe Burns. *Ann. Surg.* 1945 122 695.

The main purpose of the authors study was to evaluate whole blood transfusion in the management of burn shock in the severely burned patient. Blood volume determinations in severely burned patients soon after the burn had been received indicated a decrease in the total circulating red cell mass. It is believed that this initial loss of red blood cells may account for a considerable portion of the "masked anemia" that appears in the post-shock period in many burn patients. Other than a deficit in the red cell mass soon after the burn is received the cause of

the early anemia in burn patients has not been disclosed by any studies made by the authors. The authors do not believe that intravascular hemolysis is responsible for the major portion of this red cell deficit because in many patients there was little or no staining of the plasma with free hemoglobin. They are of the opinion that the red cell deficit is due in the main to sludging or trapping of large masses of red blood cells in the capillaries in and adjoining the burned area. The hematocrit data do not necessarily indicate the extent of the anemia in burns especially when plasma and red cells are lost in disproportionate amounts into the burned area.

The general plan of a clinical experiment was to treat the patient a burn by pressure dressings and to give intravenous whole blood infusions of 500 to 1000 c.c. every 6 hours for the first 48 hours along with enough saline and other fluids to keep up a urinary output of from 50 to 100 c.c. per hour. Every effort was made to have the patient take fluids by mouth rather than by the intravenous route. Fluids were given in the form of water soft drinks, milk or fruit juices. For children of from 1 to 5 years of age, the six hourly infusions of whole blood were usually limited to from 150 to 300 c.c. in all burned patients every effort was made to give hemoglobin level above 100 per cent during the first 4 days of therapy. Penicillin usually 100000 units daily was given to all patients.

When burn patients were given plasma alone, even in large amounts, it was not unusual to find low plasma protein levels on the fourth or fifth day especially in cases in which the burn was deep and extensive. On the other hand in the series of burns treated with large amounts of whole blood the plasma protein levels were maintained at more nearly the optimum level. This may have been due to improved blood flow through the liver during the period of burn shock, and consequently less liver anoxia in the patients treated with whole blood. Stated differently one of the advantages of whole blood therapy may be the maintenance of the liver in such a state that plasma protein production is carried on in a more nearly normal manner during the initial burn period. The authors found it possible to maintain a good urinary output even when the impression appeared to be quite marked.

The authors have been pleased to note that with whole blood therapy there has been less "toxemia" than did others receiving plasma or whole blood. The authors have been pleased with the rapidity with which growth of epithelium has taken place in burned areas that at first appeared of a depth and extent to require extensive skin grafting. An increased incidence of thrombosis has been noted in patients with hemoconcentration has been noted, and one might hesitate to give whole blood in burn patients, but it is interesting to note that in the series of 33 patients, 29 of whom survived, there was no instance of thrombophlebitis or pulmonary embolism recognizable clinically.

JOSEPH K. NABAR M.D.

Ungley, G. C., Channell, G. D., and Richards, R. L.:
The Immersion Foot Syndrome. *Brit. J. Surg.*
1945 33 17

Prolonged exposure of the extremities to moist cold insufficient to cause tissue freezing produces the well defined syndrome of immersion foot. In the natural course of a typical case of immersion foot there are 4 stages: the period of exposure and the prehyperemic, hyperemic, and posthyperemic stages. During the first two stages the feet are cold numb swollen and pulseless, and pain is not a prominent symptom. Within a few hours after rescue the feet become hot and flushed and the pulses are full and bounding. With hyperemia comes pain which is severe, burning or throbbing in character and increases in intensity for from 24 to 36 hours. Swelling increases with the hyperemia, and there is a rapid recovery of sensation from above downward until from 7 to 10 days after rescue, when a relatively stationary sensory picture is obtained. Typically the sensory loss is of the "sock" or "carpet slipper" distribution. Further recovery of sensation is slow and is dependent upon the regrowth of nerve fibers. Areas that are to become gangrenous fail to warm, remain white or blue, and blister extensively. The duration of the hyperemic stage varies from a few days to months according to the severity of the case.

The posthyperemic stage may be absent in mild cases, but in the typical case it is first manifested by a change in temperature of the feet, which become cool on exposure to mild cold. The feet remain cool for several hours and later may become permanently cold and "cold-sensitive." In some cases the feet are also heat-sensitive. Spontaneous excessive sweating of the feet is a prominent feature of the posthyperemic stage, and recurrent swelling, tingling or shooting pain, and blistering are other complaints. In about two-thirds of patients with immersion foot the hands are also affected, usually less severely.

When a limb is immersed in cold water the temperature of the digits falls rapidly to within 1° to 2° of the water temperature. The earliest records of skin temperature in immersion foot syndrome have been made in from 9 to 12 hours after rescue. At this time the digits were already warm and within a few hours reached full vasodilation level. Once the hyperemic stage is fully developed the hand or foot, except for gangrenous areas, is warmer than the upper arm or thigh and the normal vasoconstrictor gradient is abolished. Reflex vasomotor activity in response to heat or cold is absent, but returns gradually. In the posthyperemic stage the feet are almost habitually cool, and many degrees of reflex vasomotor activity may be observed. In the more severe cases there is complete failure of reflex vasodilation.

In the experience of the authors, the most significant factor in prognosis is the amount of damage to the peripheral nerves. A useful criterion is the extent of loss of sensation to cotton wool touches at the end of the first week, and cases have been subdivided into 4 groups on this basis:

Grade A Minimal cases without interference with transient interference with nerve function.

Grade B Mild cases with reversible nerve damage.

Grade C Moderately severe cases with irreversible (degenerative) nerve lesions.

Grade D Severe cases with irreversible nerve lesions and gangrene.

The essential cause of immersion foot syndrome is prolonged exposure of the limbs to cold insufficient to freeze the tissues. Contributory factors are malnutrition and exhaustion, and the relative immobility and continued dependency of the feet. Mechanical interference with circulation as from tight clothing or shoes is a factor. Chilling of the upper part of the body from wind and wetness acts by reducing peripheral circulation. The disorder may arise in extremities exposed to prolonged cold with no more damp than is provided by condensed perspiration.

The difference between frostbite and immersion foot is important but is not always clear cut. In general, frostbite causes death of tissue by freezing, and skin, being most superficial, suffers most, in immersion foot there is prolonged chilling and ischemia, which affects the tissues with the lowest biological resistance, namely nerve and muscle, most severely. Even with irreversible nerve damage there may be no loss of skin.

In the series of patients observed by the authors there were two groups of survivors from shipwreck in warm waters. Edema of the feet may follow exposure in open boats, in the tropics. This group does not form a simple clinical entity. Many of the cases resemble the peripheral vasoneuropathy observed after chilling. A number of factors are probably involved such as immobility and dependency of the feet, immersion in warm sea water, semi-starvation, dehydration, and the effects of sunlight.

Pathological material obtained from tissues affected with immersion shows that nerve and muscle suffer most severely. The peripheral nerves undergo a process of patchy Wallerian degeneration. Changes are most marked in the distal portions of the nerves and fibers of small calibre appear to suffer more severely than large medullated fibers. The clinical and pathological evidence is in favor of the hypothesis that during exposure and in the prehyperemic stage intense vasoconstriction is the predominant feature. The combination of chilling and ischemia gives rise to a peripheral vasoneuropathy. The early hyperemic stage appears to be due to release of stable vasodilator substances in the tissues, and once the effect of these has subsided, the hyperemia is maintained because of paralysis of peripheral vasoconstrictor fibers. The late vascular phenomena are more difficult to explain but it is assumed that they are the result of denervation and the subsequent re-innervation of peripheral blood vessels, which may also acquire a sensitivity to cold analogous to that seen in the Raynaud syndrome.

In discussing the treatment of immersion foot, confusion has arisen because methods which are of

value in one stage have been wrongly employed in another. During the prehyperemic stage the authors advocate an intermediate course between cooling to 2 to 5°C as advocated by some and rapid warming to 37°C , as advocated by others. The degree of warmth applied should be no greater than that needed to permit relaxation of the arteries. While warming the body exposure of the extremities to a cool atmosphere (18° to 23°C) appears to be logical and satisfactory. It is emphasized that efforts to hasten the release of vasoconstriction, whether by body warming, local warmth sympathetic block, or drugs may do harm unless steps are taken to control the degree of vasodilation when it occurs. During the hyperemic stage several methods have been suggested to limit the excessive exudation that occurs. Too rapid return of circulation Treatment by cooling alone is often sufficient and should begin as soon as vasodilation develops. The optimum cutaneous temperature for prolonged cooling is 21°C . In the posthyperemic stage and for the late sequel of a cold-sensitive state and for the late sequel of a not only for the affected extremities but for the rest of the limbs and for the trunk. Smoking should be avoided if there is a tendency to vasospasm. Occupational therapy is of value. It is in this stage that sympathectomy or sympathetic block may prove of value in treatment.

JOHN L. LUNDQUIST M.D.

Blackburn, G., and Rob, C. G.: The Abdominal Wound in the Field. *Brit J Surg* 1945 33 46

The treatment of an abdominal wound commences immediately after wounding and resuscitation is very important. This usually consists of warmth and morphine but plasma has also been used in exceptional cases. Blood has saved many lives early to great advantage. Evacuation should be carried out with the transfusion running as a second resuscitation is far more difficult and lengthy than the first. A greater use of the "in ambulance transfusion" is desirable. The morphine is preferably given intravenously but will rarely be needed after the wounded man has reached the advanced surgical center. Here the amount of further resuscitation required is assessed, the guiding factors being the blood pressure, pulse rate, and state of the peripheral circulation. It should always be remembered of course that ether used as an anesthetic is a stimulant, and that the relatively slow pulse of the average thoracoabdominal wound will quicken dramatically when the pleura and peritoneum are opened. However the majority of these patients have lost blood which requires equivalent replacement (5 pints are usually sufficient) with plasma to follow as required. Immediate operation is undertaken only on account of continued hemorrhage, especially from the mesenteric vessels, gross associated muscle wounds or prolapsed and strangulated intestine.

In view of the high mortality of exploratory laparotomy in these injuries the author stresses the need of exact diagnosis and in this connection

emphasizes the importance of auscultation of the abdomen for the presence or absence of peristaltic sounds. Thus he adduces figures from his material showing that in the presence of lesions of the hollow viscera peristalsis was present in only 5 instances and absent in 84 while in the absence of hollow visceral lesions peristalsis was present in 64 instances and absent in only 1 instance. However, he believes that absence of borborygmi indicates thorough soiling of the general peritoneal cavity.

Röntgenography has been of little value in abdominal wounds, especially with the type of machine available in forward work. Of course it is apt to be of value in the case of associated injuries which the author believes to be of great importance even providing for their operative treatment either with or preceding the opening of the abdomen.

The authors do not believe that thoracoabdominal wounds are more grave than the purely abdominal variety but that in the presence of pelvic complications the results are apt to be poor. When the rectum is intact they favor the use of the Murphy drip because with the usual venoclysis there is the danger of pulmonary edema resulting from the excessive administration of fluid into the vein after operation.

When the large bowel is perforated the authors do not subscribe to the dictum that exteriorization of wounds of the colon, wherever located is the accepted practice or at least, functional exclusion by a proximal colostomy. Sixteen of the patients were treated by suture, with 5 deaths, and 57 by exteriorization, with 26 deaths. It is believed that routine exteriorization of the right side of the colon is even simpler and safer procedure. That suture is the case in wounds of the splenic flexure where mobilization is often difficult and productive of wounds of course, these statements refer to young vigorous soldier patients at least, none of the deaths from peritonitis in this series has followed suture of wounds of the large gut. In fact in 1 case the wound of the intraperitoneal portion of the rectum was closed by multiple perforations of the small bowel from the bowel and mesentery, severe bleeding some 18 inches of ileum, some 6 hours after wound ing yet 2 feet of the ileum were resected and the rectum was sutured (without colostomy) and the patient made a good recovery.

Naturally wounds of the small intestine are the most numerous but they are relatively less noxious than the usual associated injuries (if one excludes involvement of the liver, kidneys and spleen). In fact, perforations seem to do well with single layered sutures only in contrast to the large gut for which two layers are invariably employed. Drainage of the abdomen in these cases has little to recommend it because blood, rather than intestinal contents is usually found in the peritoneal cavity. It has been the authors practice to drain the laparotomy wound when there has been gross soiling and to drain the

peritoneum only when bile or feces in large quantity has contaminated it.

Kidney wounds are of less concern at the forward station so long as the pedicle is not too severely involved when the pedicle is involved a nephrectomy may sometimes be required because of persistent hematuria.

The patient must remain in the field dressing station or the casualty clearing station following laparotomy until his general condition warrants evacuation and the abdomen can be said to be fairly quiescent this usually involves 10 days or more. The danger of sitting patients up too soon after laparotomy should always be remembered. The value of sulfadiazine (6 gm daily) in intravenous drip has already been discussed and results, as yet unpublished show sulfadiazine to be superior to penicillin in combating peritonitis. In the immediate postoperative period gastric suction and morphine are useful morphine (gr $\frac{1}{4}$ every four hours) has always proved satisfactory as a sedative for the patient and his alimentary canal, and it can usually be discontinued as soon as the bowels act. This is rare before the fourth day, but it does not mean that an enema before this is always contraindicated. It may indeed be a helpful measure in a patient with an injury of the small gut whose large bowel was loaded at the time of operation. An enema may likewise be useful as a preliminary measure before a rectal drip is started.

As regards postoperative diet, it is, at first, fluid however, careful fluid charts have repeatedly shown that a pint or more of fluid per day is retained even with continuous suction. Nutrient fluids are therefore of use. Two hundred milligrams of ascorbic acid daily are given as well.

More than 50 per cent of the deaths occur from shock or hemorrhage within 48 hours. After this, the fate of the patient depends partly on the nature and multiplicity of his wounds and the interval between wounding and operation, the most important cause of death being pulmonary (bronchopneumonia, pulmonary edema and embolism). Silent distention of the abdomen occurs quite frequently, but when not due to peritonitis it has not proved fatal in this series. Fluids other than plasma and glucose-saline solution have been employed—hypertonic saline solution for thoracoabdominal wounds with severe laceration of the lung, alkal for the patient with threatened anuria (1 per cent or 4 per cent sodium bicarbonate) and blood for the anemia which so commonly becomes evident on the fifth to seventh day when dilution has followed the initial blood loss. Fresh blood, in this case is infinitely better than the stored variety.

In the 210 cases of the authors' material there was a mortality of 37 per cent, this figure closely paralleling that of other larger series quoted elsewhere. Disappointment in the results is most common in the first 24 hours after operation when the patient is described as dying of shock, and only an elucidation of this condition is likely (in the view of the

authors) to make an appreciable difference in the mortality of abdominal surgery in the field.

JOHN W. BRIDGEMAN, M.D.

De Waal, H. L. Wound Infection. *Edinburgh M J* 1945 52 375

A knowledge of the fundamental physiological and pathological aspects of wounds will aid any surgeon in his search for methods of promoting wound healing. He should work in close co operation with his colleagues, the bacteriologist, physiologist, and pathologist and should concern himself as much with the study of infecting organisms and their effect on tissues as with the surgery and bedside treatment of wounds. The method of collection of material from wounds for bacterial investigation and the results in a series of cases are outlined and appraised.

In both old and fresh wounds swabs should be taken both before and after saline lavation and surgical treatment. Prompt culture should be made for aerobic and anaerobic organisms in the respective swabs. Results from a series of 658 wounds so examined showed: (1) insignificant infection in fresh wounds from 0 to 5 hours after injury, (2) the presence of infection in fresh wounds similar to that found in old clinically infected wounds from 5 to 8 hours after injury, (3) infection by both bacteria and saprophytes in 88.8 per cent of the cases after 8 hours, (4) a decrease of organisms in fresh wounds after cleansing and surgery, (5) that clinically infected wounds already under treatment contained chiefly nonpathogens (6 and 7) a decrease in non-pathogens but a proportionate increase in tissue invaders particularly hemolytic streptococci, in the tissue swab after saline cleansing as compared to the findings in the swab taken before cleansing (comprehensive swab) and (8) that subculture from primary fluid cultures gives an erroneous idea of the proportions of organisms.

It is emphasized that it is the invading organisms on the spreading edge and in the deep tissues of a infected lesion which must be discovered and dealt with rather than the organisms in the pus on the surface. This necessitates the two swabs, the second one taken after the pus has been removed with meticulous regard for the delicate healing tissues. Bacteriological studies in these cases showed that the staphylococcus albus, saprophytes, and other organisms were proportionately more prevalent in swabs taken before lavage, while the hemolytic streptococcus was more prevalent in swabs taken after lavage, and the staphylococcus pyogenes was found in relatively the same proportions.

It is postulated from observations that the organisms in the deep tissues prepare the susceptible tissues for later invasion by less pathogenic but more numerous invaders the latter which are prevalent in the pus and tissue detritus have displaced the less hardy but more pathogenic organisms in the pus as plants are choked by weeds. Hence, the tissue below the pus is the important area to be swabbed if the all-important invading pathogens are to be

discovered and proper therapeutic methods carried out.

PHILIP B. CHAFF, M.D.

ANESTHESIA

Beecher H. K.: *Anesthesia for Men Wounded in Battle*. *Ann Surg* 1945 122 867

Progress in the field of anesthesia in the last 30 years has made possible many of the advances of surgery. The author in this article attempts to sift out the anesthesia procedures found to be practicable in warfare and necessary for the best military pentothal, which is admirably suited to wartime surgery has had its first significant trial in this war. The author discusses its use on the basis of the experiences in the Mediterranean Theater of Operations.

A number of factors are important in the choice of anesthetic agents. Simple durable equipment is essential because of the need for rapid mobilization. The problems of supply soon convince an anesthetist that the simplest agents such as ether, sodium pentothal, and procaine hydrochloride are adequate for the forward zone. Personnel problems are important also as shown by the fact that one third of the Theater's specialists in anesthesia had only three months or less of special training.

The preoperative preparation of patients has been frequently discussed elsewhere. The author believes seriously wounded men need little preanesthetic medication. Morphine is to be avoided except for the relief of severe pain, since with a poor peripheral circulation the morphine which has been previously administered may or may not have been absorbed from subcutaneous deposits and with re-ruscitation and later vasodilatation the morphine may be rapidly taken up into the blood and poisoning occur. Atropine is important to cut down secretions when ether and pentothal anesthesia are used. Intratracheal intubation under general anesthesia is desirable for intracranial manipulation, thoracic and abdominal surgery, and in cases in which the patient's position makes it difficult to maintain the airway. Or in which the operation exceeds an hour or so. The routine use of the bronchoscope is undesirable because the trachea can be kept clean by frequent aspirations with a catheter. The insertion of the bronchoscope requires prolonged deep anesthesia which is undesirable or deepening of the anesthesia with possible harm to the patient at the end of a trying operation. If topical anesthesia is used and the patient vomits on recovery from the general anesthetic, aspiration of the vomitus is almost certain.

Ethyl chloride and chloroform are little used and cyclopropane and ethylene have not been issued to the American Army in this theater. Nitrous oxide is useful for minor surgical procedures (painful dressing changes) to supplement other forms of anesthesia (sodium pentothal) and to induce ether anesthesia as the induction of ether is not unpleasant the use

of nitrous oxide is not indispensable. Ether is the choice for the seriously wounded. If surgery is to be undertaken in patients in shock or impending shock, ether is the best tolerated anesthetic agent. Ether provides practically all the anesthesia for major cases in field hospitals. It was used too little at first, but its use has increased in the surgically important group of wounds of the abdomen and thorax and in compound femur fractures.

In September 1943 deaths from sodium pentothal were so common that the question of abandoning this agent was raised. Two correctable factors were found present when the causes of these deaths were examined: (a) its frequent use by completely inexperienced individuals and (b) its use in cases in which it was contraindicated. The advantages of sodium pentothal—its compactness and simple equipment, the smoothness of induction, the prompt awakening of the patient, the infrequent unpleasant after effects and the number of cases in which an inexperienced man can get by with it—have led to the decision to continue its use and at the same time take measures to correct (a) and (b). The disadvantages of sodium pentothal are the facts that overdosage is often difficult to overcome, that its use is incompatible with certain types of injuries and that the fatal dosage varies widely in different individuals.

Pentothal destroys the sensitivity of the respiratory center to its normal stimulus carbon dioxide. To maintain respiration a shift is made from the normal driving action of carbon dioxide on the respiratory center to the action of anoxia on the chemoreceptors. Anoxia stimulates the carotid mechanisms in the neck. Anoxia stimulates respiration under full pentothal anesthesia as well as under light anesthesia. Interpreted and more pentothal has been given. When deaths have probably resulted. In operations exceeding one half hour oxygen should be administered with pentothal and then the character of the respiration is a helpful guide to the depth of anesthesia. The use of carbon dioxide to stimulate respiration depressed by pentothal is contraindicated because under such circumstances it causes depression.

The use of a 2.5 per cent solution of pentothal the routine administration of oxygen and frequent observations of the pulse and blood pressure constitute the acceptable practice in operations requiring ether is recommended if the operation requires more time. The preoperative use of morphine requires more than one half to three fourths of an hour. A shift to not be resorted to. It may cut down the total quantity of pentothal needed but the author suggests the supplemental use of 50 per cent oxygen and 50 per cent oxygen as a better means of accomplishing this end. Atropine in a dose of 1/300 gr one hour before operation and a dose of 1/300 gr given intravenously just prior to anesthesia is recommended to cut down vagal reflexes. If laryngeal spasm occurs 1/300 gr of atropine to be given intravenously is recommended.

Pentothal is contraindicated when (a) the patient is suffering from a morphine overdose, (b) when shock is present or anticipated, (c) when cervical inflammation is present (inflammation in the region of the carotid bodies and sinuses causes sensitization of the reflexes and may lead to sudden death) and (d) in the presence of gas gangrene (since these toxins produce severe circulatory damage).

The use of pentothal is usually unwise (a) when the operative position interferes with the airway (b) in intracranial surgery because the operations are long and bloody, and the pentothal may cause sudden respiratory depression and anoxia and (c) in severe burns.

Its chief use in military medicine has been in short procedures for which relaxation is not needed and the men are in good condition.

Local and regional anesthesia with procaine hydrochloride and topical anesthesia with pontocaine or cocaine have been used for neurosurgical, maxillo-facial, and minor surgical procedures.

Spinal anesthesia is usually a poor choice for recently wounded men, because their precarious circulation rapidly deteriorates under it. Its chief use is for emergency appendectomies and conditions unrelated to warfare.

Anesthesia was given in 15,925 cases, 1,628 (10.2%) being classified as abdominal injuries 150

(9.4%) as thoracic injuries with pleural involvement, and 508 (3.8%) as thoracoabdominal injuries.

Of the men listed in the files of this theater as specialists in anesthesia, only 10 per cent were certified by the Board, 20 per cent had only the anesthetic training of an internship, and 15 per cent had from one to three months of special training in anesthesia. The total number of physicians was so small that nurse anesthetists and a few corps men were used under close supervision.

Whenever possible the ablest anesthetists were assigned to combat zones as there the demands for native intelligence, judgment, resourcefulness, and technical ability are greatest. In some instances men of unusual ability were used to train anesthetists to be sent to forward areas.

By accepting the limitations of sodium pentothal, that is, avoiding its use in badly wounded men and for providing relaxation, and using it for short procedures in men in good condition a great reduction in the death rate which has been attributed to it has been possible. At the same time, its use has increased. Thus, sodium pentothal, together with ether and procaine, takes its place as one of the three most important anesthetic agents for use in military medicine and surgery.

R. R. BULLOW M.D.

PHYSICOCHEMICAL METHODS IN SURGERY

ROENTGENOLOGY

Her L. G.: The Development of Roentgen Diagnosis. *Radiology* 1945 45 467

This article is an extensive concentrated review of the development of roentgen diagnosis. Special prominence is given to the role which contrast media played in further extending the applicability of this method. Two anatomical drawings of the human body display the organs made accessible to x-ray examination and give the name mode of administration, and the year that x-ray examination was first used for the diagnosis of disease of each of these organs. One plate shows contrast media denser than tissue, the other shows media which are less dense than the surrounding tissue. A bibliography of 326 references helps to establish historical priorities.

A table enumerates 44 groups of anatomical parts and disease processes to which roentgen diagnosis is particularly applicable. Several conditions in which x-ray diagnosis is of no avail are mentioned. Certain conditions can be diagnosed by other means at an earlier stage. In others the reverse is the case. The absence of roentgen findings may be significant in some conditions but meaningless in others and on the other hand the presence of x-ray findings may definitely indicate disease in some cases whereas in others they may not allow such conclusions. (Examples of each of these conditions are given.) The correct and incorrect use of the terms 'typical finding' and 'characteristic finding' is discussed. All these facts and problems show that only the correlation with clinical findings and the knowledge of disease aspects make it possible for one to arrive at the correct degree of emphasis with which a given x-ray finding should be appraised. As a general rule, a negative roentgen examination is much less significant than a positive one the most important exception being in chronic pulmonary tuberculosis.

As far as the future of roentgen diagnosis is concerned one may safely assume that practically no competing diagnostic procedure will replace this method. Usually the institution of other methods of examination, e.g., gastroscopy has given a further stimulus to roentgenology. The roentgen examination of the liver pancreas and spleen has not yet been perfected thus presents a inviting goal to the ambitious radiologist. Body time examinations at regular intervals, not only of the chest but also of the stomach (at least in cases with achlorhydria and a familial history of pernicious anemia) might lead further social importance till in its infancy. The detection of initial lesions is

Great progress in diagnostic roentgenology is to be expected when electronic image amplification will allow the production of incomparably brighter fluoroscopic pictures with negligibly small intensities of x-rays. Then motion and multiple projection studies will become a commonly used method and roentgen cinematography will no longer encounter its present difficulties. This may contribute to a shift of roentgenological interest from anatomical lesions to abnormalities in organ physiology and minor changes in the function of organs.

GRIFFITH S. SCHWARTZ M.D.

Arbuckle, R. K., Shelden C. H. and Pudenz, R. H.: Pantopaque Myelography: Correlation of the Roentgenological and Neurological Findings. *Radiology* 1945 45 355

The authors have analyzed 100 consecutive cases with a provisional clinical diagnosis of protruded intervertebral disc, all in naval personnel, of whom 87 were subjected to pantopaque myelography. Most of the men were between 20 and 30 years of age and 50 per cent of them had had symptoms for only 6 months or less and 70 per cent for not more than one year. The commonest types of trauma associated by the patient with onset of the symptoms were the lifting of heavy objects falls or slipping on wet surfaces without falling.

Preliminary filming of the lumbosacral area showed a list of the lumbar vertebrae either toward or away from the side of the lesion in 47 cases loss of the normal lumbar lordotic curve in 37 cases and narrowing of the intervertebral cartilage space in only 13 cases. However bony proliferation and narrowing of the cartilage space concerned were present, almost without exception in those patients who had had symptoms for over 3 years.

The injection of 3 c.c. of pantopaque in the lower lumbar region was done usually with the patient prone on the tilting fluoroscope. Defects even partial obliteration of an axillary pouch or slight elevation of a nerve sleeve were searched for both with oblique, cephalad and caudad, and spot films were made with the patient in the prone or even in the oblique position. Lateral views gave no additional information and were abandoned. At the conclusion of the examination, pantopaque was pooled at the tip of the needle and in 70 per cent of the patients about 50 per cent of the oil was removed. With experience the time for the whole myelographic procedure totaled 20 minutes. The authors observed no toxic manifestations or signs of root irritation and no more headache or signs of root irritation routine lumbar puncture was complained of than after an operation was performed in 13 cases of this series of 100 without myelography, in a group of 5 cases myelography was unsuccessful because of subdural injection. Among the 83 cases in which mye-

lography was performed after successful opaque injection, the procedure was diagnostic of two protruded discs in each of 3 patients diagnostic or questionably so of a single protruded disc in 53 cases of a disc and tumor in 1 case and of a tumor alone in 4 more cases—all proved at operation. Three more cases had clinical and myelographic evidence of protruded disc but were not operated upon another 2 had positive myelograms but were negative at operation 7 were negative at myelography but showed a protruded disc at operation, and 9 more which were negative myelographically were not operated upon. All but 1 of the 83 protruded discs found were caudal to the fourth lumbar vertebra whereas of the 5 tumors encountered 4 were above the fourth lumbar and below the eleventh dorsal vertebra.

The authors were concerned particularly with the group of 7 cases which were negative at myelography but revealed a protruded disk at operation, and found that all of these cases had a narrow subarachnoid space measuring 6 mm or less in diameter as did also the 10 cases in which myelography was only questionably positive. On the other hand, there was operative confirmation of the roentgen findings in all of the cases with a subarachnoid space wider than 16 mm. Even with a narrow subarachnoid space, midline or large posterolateral protrusion offered no myelographic difficulties. Failure to demonstrate the lesion occurred in patients having both a narrow subarachnoid space and a posterolateral protrusion too small to encroach either on the narrow column of pantopaque or on the adjacent nerve sleeve or pouch. No correlation existed between the interpedicular and subarachnoid widths.

The authors conclude (1) that roentgenograms of the lumbosacral spine without the aid of myelography are of little definite help in the diagnosis of protruded intervertebral discs (2) that pantopaque is a satisfactory medium for myelography because of the ample contrast, its lack of irritating properties, low viscosity, and ease of removal (3) that myelography should be carried out as an aid in diagnosis and localization of single or multiple protruded discs, and in differentiating them from tumors and (4) that a negative myelogram in a patient whose subarachnoid space measures less than 16 mm. does not preclude the presence of a protruded disc.

LILLIAN DONALDSON M.D.

Schnitzler M T and Booth G T: Pantopaque Myelography for Protruded Discs of the Lumbar Spine. *Radiology* 94:3, 45 370.

Pantopaque, a radiopaque mixture of isomeric ethyl esters having a provisional principle constituent of ethyl iodophenylundecylate, and containing 30.5 per cent of iodine in firm organic combination was used satisfactorily by the authors for diagnostic myelography in 100 patients of a total of 313 with low back pain who were admitted to the surgical service of Bushnell General Hospital, Brigham City Utah.

Thirty of these 100 cases showed myelographic evidence of protruded intervertebral disc, multiple in 3 patients, which was verified at operation. Another 5 cases, negative at myelography showed protruded discs at operation, and 2 cases positive myelographically proved negative at operation. These 2 "false positives" occurred early in the series and the visualized defect reported at first as evidence of an extradural mass, was on review found to be due to the needles being left in place at the time of myelography an error of interpretation which was later avoided. Thirty-seven was the total number of patients operated upon. A review of the premyelographic roentgenograms of the lumbar spine in the 35 cases in which a protruded disc was found at operation showed a definite narrowing of the intervertebral disc in only 7 cases.

The technique of the procedure is recorded in detail. In more than 80 per cent of the cases subjected to pantopaque myelography, over 80 per cent of the injected oil was removed at the end of the procedure. The authors stress the desirability of avoiding the suspected site of lesion as the site of injection because injection and subsequent removal may be more difficult, the needle may strike the lesion and enhance or distort it, or the needle itself may create a defect as reported.

A reaction occurred in 3 cases in this series of 100, manifested by symptoms of meningismus and elevation of the cell count, and in 2 instances by increase in the total protein in the spinal fluid, but rapid recovery occurred without sequelae. The degree of reaction, as gauged by changes in the spinal fluid, was not directly proportional to the amount of oil retained.

The authors conclude that the verification of the presence of a protruded intervertebral disc or other intraspinal lesion and the accurate localization and occasional demonstration of a multiplicity of the lesions make the use of myelography with pantopaque (which they prefer to air or lipiodol) advisable in indeterminate cases of low back pain with acute

LILLIAN DONALDSON, M.D.

Gershon-Cohen J: Internal Derangements of the Knee Joint; The Diagnostic Scope of Soft Tissue Roentgen Examinations and the Vacuum Technique Demonstration of the Menisci. *J. Resid.* 1945, 54 338.

The value of the roentgen examination of the soft tissues and menisci of the knee has repeatedly been stressed.

It is not necessary to resort to special techniques. The addition to the routine examination of the knee in the anteroposterior and lateral views of the longitudinal view of the patella and of bilateral views of the menisci will suffice. If any abnormal findings are disclosed, further oblique and so-called lateral condylar views may be supplemented.

It is important that for the viewing of each roentgenogram one be supplied with a source of light which has wide variable intensities and that the

field of illumination can be regulated in size and shape for optimum visualization of the soft structure outlines.

The technique employed by the author for bilateral anteroposterior views of the meniscus is briefly described. In the interpretation of the findings, no significance is attached to irregular margins or defects of the meniscus since they may occur under normal conditions. Only the nonvisualization of the meniscus carries diagnostic weight because demonstration of the meniscus is impossible. It must be mentioned however that even with the best techniques, the internal meniscus can be demonstrated in not more than 80 per cent and the external meniscus in not more than 30 per cent of all the cases. If therefore the meniscus cannot be demonstrated in either knee joint it is presumed that the patient falls into the small 20 per cent group in which the internal meniscus cannot be demonstrated and thus the findings have no clinical value.

The finding of slight excess synovial fluid in an acutely injured knee evidenced by a failure to demonstrate the meniscus suggests abnormal changes especially if the opposite side appears normal. There may be an actual fracture or loosening of the attachment of a meniscus or a swelling of the tibial collateral ligament resulting from a sprain. Occasionally the demonstration of the meniscus in a swollen knee will indicate absence of excess synovial fluid, and suggest a periarthritic rather than an intra articular swelling.

The author discusses in detail the clinical symptoms and the significance of the roentgen findings by the above method in internal derangement of the knee joint: loose bodies, sprain or rupture of the tibial collateral ligament, periarthritic bursitis of the meniscus, and neoplasms. Typical roentgenograms are used for the purpose of illustration. The conclusion is reached that the roentgen study of the soft tissues of the knee in conjunction with examination of the meniscus is of definite practical value.

Garland, L. H.: X Ray Burns from Fluoroscopic of the Gastrointestinal Tract. *J Am Med Ass.* 1945 129: 419.

Knowledge of the effects of x rays on the patient is not kept pace with the increased roentgenological work done in both military and industrial hospitals. The newer machines may be even more dangerous than the nonhomologous. Since the intensity of x-rays varies inversely with the square of the distance, the nearer the tube is to the patient the greater the possibility of skin damage. For adequate protection, the following factors should be borne in mind: adequate distance, reason-able voltage, low milliamperage, small fluoroscopic field and as minimal fluoroscopic examination time as possible. The latter applies especially to the manipulation of fractures under fluoroscopic control for long periods of time. Such procedure frequently

results in permanent skin damage both to the patient and doctor.

Four cases of x ray burns that resulted from prolonged exposure during the course of gastrointestinal examinations are reported. The author stresses the point that x ray burns resulting unnecessarily from fluoroscopy can be avoided by using a safe distance between the tube and the patient (from 12 to 18 inches), 1 mm. of aluminum filter (from 12 to 18 inches), a beam size not larger than 6 square inches, no more than 3 minutes of exposure per examination, and no more than 4 such examinations per month. Above all proper adaptation (at least 10 minutes) of the examiner's eyes is essential in fluoroscopic work.

MAURICE D. SACCS, M.D.
Pelice, C. B., Cone W. Y., Elridge, A. E., and Tyso J. G.: Roentgen Therapy of Primary Neoplasms of the Brain and Brain Stem. *Radology* 1945 45: 247.

The authors treated between January 1, 1939 and December 31, 1943 a series of 91 cases of primary malignant neoplasms of the central nervous system by roentgen therapy. Of these 60 cases have been followed up and 25 patients were found to be either alive and well or alive and well save for residual symptoms.

In the beginning a more conservative procedure was used consisting of from 3,000 to 6,000 r (in air) which were dividing over multiple ports and given in several series at 3 month intervals but later the total dose was raised from 10,000 to 15,000 r (in air). The factors employed were roentgen rays of 2.0 mm of copper high voltage layer with Thorax filter at 50 cm. focal skin distance. The initial dose was 100 r per day to each of two fields. If no significant

TABLE I — THE SURVIVAL RATE IN RELATION TO THE TUMOR DOSE

Type of tumor	Postoperative, postirradiation survival	Maximum dose in roentgens	Minimum dose in roentgens	Average dose in roentgens
Glioblastoma multiforme 5 patients alive	0-47 mo. Average 7 mo.	—	—	—
20 patients dead	—	—	—	—
Astrocytoma 3 patients alive	6-41 mo. Average 24.3 mo.	3,600	6,300	9,750
8 patients dead	—	—	—	—
Astroblastoma patient alive	6-41 mo. Average 7 mo.	14,800	6,300	8,400
patient dead	—	—	—	—
Ependymoma patients alive	2.3 mo. 6 mo.	—	—	—
patient dead	—	—	—	—
17-40 mo. Average 28.5 mo.	7,300	6,850	7,400	—
9 mo.	—	—	—	—

TABLE II — SURVIVAL AS RELATED TO THE TYPE OF TUMOR

Type of tumor	No. of cases	Postoperative and postirradiation survival		
		Alive—years	Alive—months	Average
(A) Glioblastoma multiforme				
Alive and well		47 mo	3 mo	8.5 mo
Alive with residual symptoms		—	—	11 mo
Alive with marked symptoms		—	—	47 mo
Dead	30	8.4 mo	mo	14.5 mo
(B) Astrocytoma				
Alive and well		64 mo	mo	44.6 mo
Alive with residual symptoms	3	—	—	46 mo
Dead	6	44 mo	mo	7 mo
Anaplastic				
Alive and moderately well		—	—	34 mo
Dead		—	—	6 mo
(C) Ependymoma				
Alive and well		40 mo	7 mo	28.5 mo
Dead		—	—	9 mo
Meningioblastoma				
Alive and well	3	40 mo	13 mo	27 mo
Alive with residual symptoms		—	—	36 mo
Dead	3	7 mo	6 mo	6.6 mo

reaction developed within from 8 to 10 days the dose was increased to 150 r per field. The tumor dose approximated 90 per cent of the total roentgens in air for the frontal lobe lesions 83 per cent for the temporal and parietal lesions and 71 per cent (76.5 per cent for children) for the occipital lesions. The survival rate in relation to the tumor dose is shown in Table I.

The scalp tolerated the amount of radiation given very well. Regrowth of hair has been excellent even after 15,000 r.

The mental state likewise improved considerably co-ordination returned, and, although some aphasia or ataxia remained the mind cleared. In not a few of the cases the formerly-held responsible positions in society could be resumed.

The survival period depended to a certain extent on the type of tumor. This is shown in Table II.

As may be seen, glioblastoma multiforme had an almost reciprocally low proportion of survivors as compared with astrocytoma. Tumor doses in excess of 7,500 r will be required.

As a whole, definite clinical improvement was effected by roentgen therapy of the malignant primary neoplasms of the brain and brain stem. No late degenerative changes have been observed which could be attributed to the irradiation.

T. LECURIA, M.D.

Fairchild, G. C., and Shorter, A.: Direct Irradiation of Cancer of the Stomach and Other Viscera Exposed Temporarily at Operation. *Lancet*, Lond., 1945 249: 58.

The authors report that the end-results of carcinoma of the stomach are poor. In their experience, the percentage of 5 year cures has been from 1 to 10 per cent and they believe that in most instances failure is due to (1) late diagnosis of lesions that are inoperable, (2) incomplete surgery and (3) irradiation. Results with external irradiation have been poor because of the necessity of avoiding injury of neighboring organs and the radioresistance of gastric tumors. Contact therapy covers small areas, at a depth of more than 1 cm., with little effect. Unequal distribution of irradiation is one of the faults of radon and implantation. The use of intracavitary irradiation, as advocated by Livingston and Puck, has been limited because of the fact that the tolerance dose has not been established.

In view of the poor results which have been obtained in the treatment of gastric carcinoma, a new approach—direct irradiation at the time of surgery—to improve the percentage of 5 year cures, was deemed feasible. The advantage of this method is that neighboring organs are protected, also, the tumor dose may be high because radiation therapy will not be worried by skin effects such as are seen following external irradiation.

The authors used this method of irradiation not only on gastric lesions but also on cancers of the esophagus and of the colon. In all instances there was at the time of surgery, consultation between the surgeon, the radiation therapist, the pathologist, and the anesthetist as to the best form of therapy. In radiation therapy, 5 units were used simultaneously (one anteroposteriorly, directly to the lesion, and the other posteroanteriorly through the skin to the lesion). Earlier in the series, only 1 unit was used. It was believed that with 5 units a greater and more effective tumor dose could be delivered at one time and that it would not be necessary to give supplementary external irradiation, as had been required when only 1 unit of radiation therapy was used.

Fifteen patients were treated in the manner reported viz., 9 with cancer of the stomach, 3 with cancer of the esophagus, 2 with cancer of the colon, and 1 with cancer of the pancreas. The tumor dose was 1,300 roentgens. Of the 15 cases, 6 were palliative. No unusual postoperative radiation complication has been observed.

The authors are of the opinion that this method is of value and that it is a reasonable approach to the problem of visceral carcinoma.

MAURICE D. SACKS, M.D.

Golin, L. S., and Hoffman, E. F.: Contact Roentgen Therapy in Cancer of the Bladder. *Am. J. Roentg.* 1945, 54: 392.

The authors have now modified the method of treatment of carcinoma of the bladder on which they reported in 1940 and which consisted in marsupialization

tion of the bladder with subsequent contact irradiation of the tumor by low voltage roentgen rays and are using instead suprapubic cystostomy under spinal anesthesia and reduction of the tumor to its base by fulguration, followed by direct irradiation of the tumor with one or two reopenings of the bladder for further irradiation.

The apparatus employed is a Philips-Metalix operating at 50 kv., constant potential, and 3 ms. with a shock proof tube 23 inches long and slightly less than 2 inches in diameter at its active end. The anode is 2 cm. from the surface of the tube and the roentgen afflux is 1.543 per minute with a filter of 1 mm. of aluminum. This construction permits easy introduction of the tube, encased in a sterile stock inette and rubber sheath, through the cystostomy wound. The target surface distance used is 22 mm. and a first dose of 5,000 r. in air is administered to the base of the tumor. Most cases treated have had two cystostomies about 1 week apart, and have received a total dose of 10,000 r. Only moderate sloughing followed the treatments and no severe hemorrhage, perforation or fistula formation resulted, nor was there any primary mortality.

Treatment was limited to tumors not more than 3 cm. in diameter involving the trigone of the bladder since the alternative in trigone tumors is total cystectomy with its high primary and secondary mortality. The 3 cm. limit is considered important since greater size of the tumor would necessitate the use of several circular fields with either resultant dosage overlap or failure to include some small irregular areas in the treatment. For neoplasm of the vault or lateral walls of the bladder the authors prefer local resection if possible. They rationalize the use of this combined surgical and radiation procedure as follows:

Cancer of the bladder tends to metastasize rather late in its course and is often fairly radiosensitive and by contact irradiation a large dose can be administered to the tumor base without irreparable injury to the adjacent tissues. It is estimated that with a circular field 3 cm. in diameter and factors the same as specified previously the dose at a depth of 1 cm. is only 32 per cent of the surface dose, and at 4 cm. only 3.6 per cent.

The authors treated a series of 31 trigone tumors in this manner of which 13 were papillary and 18 infiltrating carcinomas, ranging from grades 1 to 4 with grade 3 predominating. The first 4 cases were subjected to marsupialization and received 10 or 11 treatments each at weekly intervals up to a maximum of about 28,000 r. in air in 22 days. The other cases were subjected to cystostomy and of these 15 received about 10,000 r. and some of the others less the minimum being 5,148 r. which were received in a single treatment. In addition to the original biopsy, a second biopsy was done in 20 cases at the final treatment and no cancer cells were found in 13 of these.

A survey of the results of this 5 year study showed 10 patients dead of cancer 9 of them within the

first year of treatment and 1 after 4 years. Two others are dead but they presented no evidence of cancer at postmortem examination. Of the 19 survivors 3 have so far lived 5 years another 3 for four years 5 have lived 3 years, and the rest from 1 to 2 years.

The authors have compared their results with those obtained elsewhere by total cystectomy radon seed implantation, and high voltage external irradiation and believe them to be at least as good as those obtained so far by these other methods. Further in view of the low primary and secondary mortality in their series they consider the method of contact irradiation preferable to total cystectomy for trigone tumors.

LILLIAN DONALDSON M.D.

Borak, J. and Taylor H. K.: Beneficial Effects of Roentgen Therapy in Advanced Cases of Rheumatoid Arthritis; Preliminary Report. *Radiology* 1945 45 377

A number of investigators have reported favorable results from roentgen therapy of various forms of arthritis such as gonorrheal arthritis, tuberculosis, gout, osteoarthritis and hypertrophic spondylarthritis. However in the rheumatoid (atrophic, proliferative) type of arthritis roentgen therapy has been regarded as less satisfactory.

The authors have again studied this subject and during the past two years have treated 60 patients with advanced rheumatoid arthritis by means of roentgen rays. These patients had failed to respond to the usually accepted methods of gold therapy, vaccines, physiotherapy, surgery, or any other method. Ten patients, with a total of 85 joints affected, were selected for a critical study. The cases are tabularly arranged attention being given to the following factors: age, sex, duration of the disease in years previous therapy, present roentgen therapy (joints involved, stage and dose) and the results obtained.

Rheumatoid arthritis is divided—mainly on the basis of the degree of impairment of the mobility—into 3 stages: first stage, in which pain and soft tissue swelling restrict the active mobility of the joint although passively it can be moved through its full range; second stage, in which the mobility is restricted both actively and passively to a varying degree; and third stage in which there is no motion at all.

Roentgenographically, in the first stage the joint space is normal although there may be a swelling of the periarthritic tissues and some decalcification of the bones. In the second stage there is usually a narrowing of the joint space, and sometimes destruction of the subchondral adjacent bone and in the third stage there may be complete ankylosis.

Pathologically in the first stage the cartilage may appear nearly or quite normal and the only visible change may be in the synovial membrane. The second stage is characterized by the formation of granulomatous tissue and the third stage is marked by destruction of the cartilages and their replacement

either by fibrotic strands or osteoid tissue until complete ankylosis results.

The roentgen dose is gauged as follows: for inflammatory edema, from 50 to 100 r in 1 session; for chronic inflammation, from 200 to 300 r in 1 to 3 sessions; for hyperplasia, from 800 to 1,200 r in about 3 weeks; and for granulomatous tissue, from 1,200 to 1,600 r in about 3 weeks. In the series mentioned the majority of patients received from 800 to 1,600 r. The factors were: 200 kv., 0.5 mm. of copper plus 1.0 mm. of aluminum, 20 ma., 50 cm. distance, H.V.L. of 0.9 mm. of aluminum. Each port was treated three times a week, some joints being cross-fired through 2 or 3 ports at each session. In multiple joints two joints were treated alternately so that treatment was given daily.

The results were good in most cases. Relief of the local symptoms, alleviation of pain, and even some increase in mobility were noted.

T. LEUCOTIA, M.D.

MISCELLANEOUS

Hinkel, C. L.: The Entrance of Pantopaque Into the Venous System during Myelography. *Am. J. Roentg.* 1945 54: 230.

Pantopaque used as a contrast medium in myelography is a valuable diagnostic aid. It contains 30.5

per cent iodine and up to the present has given rise to no complications.

A case is reported wherein some of this substance was seen entering the neighboring venous system during the course of myelography. A complete survey of the body over a 2 month period failed to reveal any evidence of dye or any other abnormality. The patient showed a low grade temperature of 99.4 F with a 13,000 white count for the next two days, which subsided on the third day. Urine examination within the first 24 hours showed 564 mgm. of iodine in 1,100 c.c. of urine. Re-examination of the urine two weeks later showed a trace of iodine.

Pantopaque is not intended for intravenous use, and up to the present time no case of this kind has been reported. This case was reported as a curiosity rather than as a complication. Little is known of the hydrolysis, breakdown, and excretion of pantopaque. Studies are still being made by many investigators.

How the medium got into the venous system is not clear to the author. It is thought that the vessel may have been injured by the spinal needle and when the patient coughed during the normal course of examination, the wall of the vein ruptured and the dye entered the vein. At all times, manifestations of toxicity were slight and there was no evidence of embolism.

MAURICE D. SACRE, M.D.

MISCELLANEOUS

CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Albaugh, C. H.: Congenital Anomalies following Maternal Rubella. *J Am M Ass* 1945 129 719

The author reviews the reports of Gregg, Reese, Swan and others on the occurrence of congenital defects following maternal rubella and reports an additional 9 collected and personal cases.

Of the 9 cases studied by the author 7 of the mothers had rubella, 1 morbilli, and 1 was exposed to morbilli. All of these cases occurred within the first 10 weeks of pregnancy and 4 occurred in the first 4 weeks.

Eight of the 9 infants had bilateral congenital cataracts and in 7 the pupillary reactions to light were poor. Strabismus was noted in 7 cases and nystagmoid movements in 4. No glaucoma was noted. Eight of the infants had congenital heart defects and 4 of these showed evidence of cyanosis. Two infants died of cardiac failure. Five of the infants had definite microcephaly and 3 were recorded as uncertain cases. Retarded development was noted in all cases, and 7 were considered feeding problems.

The author concludes that available data would suggest that 100 per cent of the mothers who contract rubella in the first two months and approximately 50 per cent of those who have rubella in the third month will give birth to infants with congenital abnormalities. The most common lesions are congenital cataracts, cardiac defects, deaf mutism and microcephaly. Poor development of the infants and feeding problems are common.

ORLAND B. SCOTT, M.D.

Walsh, F. M. R.: "Acroparesthesia" and So-Called "Neuritis of Women's Hands and Arms." *Brist M J* 1945 2: 596.

A syndrome found chiefly in women and characterized by numbness, tingling and uselessness of the hands and fingers is described and its etiology and treatment are discussed. It generally is seen in two groups of women: (1) middle-aged or elderly women who especially in wartime have had to carry a unwanted manual effort, and (2) younger women who are burdened by childbirth in addition to factory or house work. Factors common to all cases are fatigue and debility and the heavy use of the hands and arms. Symptoms begin gradually, attain maximum severity after some weeks or months, and thereafter fluctuate in severity according to the condition of the patient and treatment. They consist of paresthesias most severe on arising, waning during the day's work but increasing in the evening, often to the extent that they awaken the patient during the night. Positioning of the arms may offer temporary relief. These subjective symptoms predominate

although certain objective signs such as chronic fatigue, atonic musculature, low-set shoulder girdles and a rare obliteration of the radial pulse on traction of the dependent arm suggest the syndrome. Rest alone gives permanent relief; such measures as vitamin therapy, physiotherapy, estrogens or thyroid extract are superfluous.

The etiology is thought to be mechanical, in the altered topographical relationship between the shoulder girdle and the normal upper thoracic outlet. The lower components of the brachial plexus and on occasion the subclavian artery are compressed between the first rib and the clavicle which acts under the general atony of the muscles supporting the shoulder girdle. Pressure syndromes associated with a rudimentary seventh cervical rib or an abnormal scalenus anticus muscle should of course be ruled out; however these syndromes are usually unilateral and present more evidence of vascular disturbances in the arm than the less severe normal pressure syndrome of the first rib which is here described. No relationship has been found between the syndrome and pregnancy per se.

Rest in bed or the simple cessation of manual work produces appreciable relief and final disappearance of the symptoms. Initially a week in bed and a sedentary position during the day with the arms in slings, effectively brings relief to the patients. Abstinence from heavy work, with the arms supported in slings for a longer period when possible, together with shoulder massage and general tonic treatment, tends to prevent recurrence. Analgesics may be used as an adjunct.

PHILIP B. CHASE, M.D.

Corcoran, A. C., and Page, I. H.: Post Traumatic Renal Injury: Summary of Experimental Observations. *Arch. Surg.* 1945 51: 93.

The nature and treatment of post traumatic renal injuries were studied experimentally by means of investigations of the renal function in the following states: (1) hemorrhagic shock, (2) tourniquet shock and (3) simulation of the crush syndrome.

Shock due to hemorrhage was produced in dogs by repeated severe bleeding and transfusion. The shock due to prolonged or repeated bleeding is believed to cause a depression of the renal function by causing a vasoconstrictive ischemia which is not released by the transfusion of blood and restoration to normal of the arterial pressure. The persistence of renal ischemia and anoxia in experimental shock due to bleeding seems to explain the prolonged depression of renal function which may follow bleeding in human beings. Therapeutically it is significant that renal denervation does not prevent the vasoconstriction; hence, there is no experimental basis for the treatment of posthemorrhagic urinary suppression by spinal anesthesia or paravertebral block.

The nature of the abnormality makes the use of vasoconstrictor drugs illogical.

To study the conditions of crush syndrome, the renal function in dogs was observed during the onset of shock resulting from the experimental application of tourniquets partially occluding the arterial inflow. Renal vasoconstriction develops more rapidly and more severely during the onset of shock due to skeletal trauma than in shock due to bleeding in which tissue damage is milder and more diffuse.

The severe renal damage of the crush syndrome seems to depend on the combination of renal damage from trauma and that caused by muscle pigment. Both post traumatic renal ischemia and myoglobinuria were then produced in rats by the application of a tourniquet and the injection of myoglobin. Dogs were not satisfactory for this experiment as trauma severe enough to cause severe renal ischemia was followed by death within 24 hours, whereas minor trauma was followed by recovery. Renal damage is apparently produced by a combination of vasoconstrictive ischemia, oliguria, and aciduria, with deposition in the kidneys of muscle pigment or myoglobin.

In applying these principles to treatment, the prevention of the deposition of pigment is accomplished by reversing the conditions of oliguria and aciduria, which favor it. The treatment of shock by transfusions and pressure bandages inhibits the renal vasoconstriction on which oliguria may depend. A free flow of urine may occur during the re-establishment of blood volume by transfusion, and when this is not achieved or maintained gelatin may be added to an infusion of sodium lactate containing calcium lactate, since gelatin is itself mildly diuretic. A small dose of another diuretic such as sodium sulfate may be given. However the dangers and the ineffectiveness of alkalinization by the injection of citrate as the sole means of treatment are pointed out. LUCIAN J. FROST, M.D.

Abbott, W. E., Filling, M. A., Griffin, G. E., Hirschfeld, J. W., and Meyer, F. L.: Metabolic Alterations following Thermal Burns. *Ann. Surg.* 94:5 678.

In recent years there has been some controversy concerning the best means of combating shock in severely burned patients. Although there are a number of methods which apparently suffice to tide patients over the critical 48 hour period following an injury, their influence on the subsequent course of the patients is not well understood.

The authors compared a group of patients who were treated with plasma with another group who received whole blood intravenously and an electrolyte solution orally. The changes observed in various blood constituents and in the elimination of water and salt were recorded.

From the work presented and previous experimental work the authors draw the conclusion that the giving of whole blood early prevents or alleviates the anemia which occurs so commonly during

convalescence from a burn. Previous observations demonstrated the fact that a state of overhydration may in some instances, contribute to a decrease in the hematocrit, and also in the plasma protein concentration.

Patients with a severe or moderate burn accumulate large amounts of fluid in the traumatized area regardless of the type of therapy employed to combat shock, but it has seemed that the edema diminished more rapidly when salt solutions were used than when large amounts of plasma were administered. When plasma is given much additional protein is provided, but there is no evidence to show that the plasma protein in itself is of more than temporary value in these burned patients. In some of the authors' patients who received large amounts of plasma, low protein values were encountered, and in 3 of the severely burned patients these low values persisted until death. There is no reason to suspect that the giving of whole blood would be more beneficial than plasma for the prevention of hypoproteinemia, but the evidence indicates that the giving of plasma does not prevent the decrease in the plasma protein concentration.

It has been generally believed that by increasing the blood osmotic pressure by the addition of plasma proteins, especially albumin, shock could be prevented or corrected. In peripheral circulatory collapse resulting from a burn, however, the plasma is rapidly lost. Thus, most of the osmotic effect of albumin or of the entire plasma proteins is transient and when it is lost through the capillary walls into the injured area it must continue to exert an osmotic pull toward the injured tissues because of the protein which has then accumulated in that region. Since much of the administered protein is lost in patients in shock resulting from a burn, it would seem as though the best treatment would be (a) to give a substance which exerted an osmotic effect and would not be lost, (b) to render the injured capillaries less permeable, if this is possible, or (c) to increase the tissue tension to a point at which fluid would no longer tend to leave the capillaries in excessive amounts.

Apparently there is a substance derived from the surface of fresh plasma which has a coating effect and therefore tends to decrease the respiratory permeability. Therefore, it would appear as though whole blood or plasma would have some advantage over a salt solution alone, but since capillary permeability cannot be quickly or completely restored to normal, it would seem logical to give an electrolyte solution so that tissue tension would be increased.

From the results presented by the authors it can be seen that wide differences were found in the hematocrit readings during the period of shock, which could not be correlated with the extent and depth of the burn. The hematocrit, therefore, is frequently a poor guide to the type and amount of treatment that is necessary, especially since it is influenced by a pre-existing anemia, and the rate and number of cells destroyed or trapped from the

general circulation at and following the time of injury and because the normal hematocrit varies quite widely.

In the treatment for the first 48 hours it seems logical to give approximately 50 c.c. of blood to adult patients for every per cent the body surface is burned, or to give blood in amounts equal to from 1 to 3 per cent of the patient's body weight in kilograms. In employing the electrolyte solution it seems desirable to give a slightly hypotonic solution (from two-thirds to three-quarters strength) in order to increase the rate of urine excretion and in amounts equaling from 10 to 15 per cent of the patient's body weight during the first two days following the burn. Since there has been little experience with this form of treatment no absolute rules should be employed, but the treatment should be modified according to the severity and the degree of the burn and the size and response of the patient. When shock is not severe treatment may be given relatively slowly but if the patient shows evidence of peripheral vascular collapse therapy should be carried out rapidly until the condition has improved and urine is being excreted. It should be remembered that the larger quantities advocated are comparable to giving amounts of fluid which are roughly equal to an individual's total extracellular fluid volume (plasma and interstitial fluid volume), hence, when such amounts are employed additional liquids and foods should not be given or should be permitted only in small quantities for the first two days, as this would lead to an excessive fluid intake. If it seems desirable, dextrose can be added to the fluid to provide calories or some form of protein could be added to the electrolyte solution. In severely burned patients it has seemed that high caloric and protein intakes are better avoided initially. The authors usually give from 800 to 1,000 calories in the form of dextrin maltose daily for the first several days which supplements the vitamin intake by from two to five times the normal daily requirement.

In most of the patients excessive hemoconcentration was not encountered when whole blood was given provided an adequate amount of salt solution was employed.

When the hematocrit is definitely elevated (from 55 to 60 or more) the patient's blood pressure is low and little urine is being excreted, the authors see no reason that plasma should not be given instead of whole blood if it seems to be desirable. By the addition of red cells more oxygen might be carried to the tissues and, hence, anoxia prevented but it probably is not wise to increase the proportion of cells too much or the beneficial effect will be overcome because of stasis and a slowing of the circulation. Therefore if hemoconcentration is not excessive it probably would be preferable to give whole blood intravenously and an electrolyte solution orally but if the hematocrit rises to 60 or above plasma or a concentrated albumin solution should be temporarily substituted for blood. JOSEPH K. NARAT M.D.

Rislin H. and Thompson K. J.: Structural Changes in Early Filariasis. *Arch Pathol Chic.* 1945 40 320.

The present report is based on a study of 30 cases of early filariasis. An eosinophilia of from 6 to 11 per cent was found in 60 per cent of the cases. In the majority of the patients painful enlargement of the superficial lymph nodes of the arm or leg was the first physical sign. In 40 per cent of the cases the genitalia and the lower extremity were involved in a brawny edematous lymphangitis or an acute epididymofuniculitis. In 30 per cent both the upper and lower extremities were involved in the disease process.

Biopsy of the lymph nodes showed the presence of the filaria (*Wuchereria bancrofti*) in 20 per cent of the slides while in the other 80 per cent the histology was characteristic of filariasis but the organism was not shown.

During the early stage of invasion, the lymph nodes exhibited extensive hyperplasia of the primary and secondary lymph follicles and eosinophilic infiltration. The lymphatic vessels contained a pink like albuminoid fluid characterized as fluid lakes. The entire histological picture was in conformity with that of an acute systemic allergic reaction with manifestations of eosinophilia, edema, and hyperplasia. The subacute and chronic phases of the disease were characterized by an epithelioid cell endolymphangitis and perilymphangitis culminating in a typical granulation tissue reaction and finally fibroblastic proliferation.

Elephantiasis occurred only in those cases in which secondary streptococcal invasion took place. BENJAMIN G. P. SHARROFF M.D.

Roth G. M. and Kvale W. F.: A Tentative Test for Pheochromocytoma. *Am. J. Med. Sc.* 1945 210 653.

Paroxysmal hypertension and associated symptoms characteristic of the clinical syndrome caused by pheochromocytoma have frequently been described but the differentiation from such clinical conditions as coronary occlusion, hyperthyroidism, histamine cephalgia, migraine, menopausal and anxiety states, and persistent hypertension may be difficult. The most confusing cases are those of the hyperreactors and those in which the patients have essential hypertension with extremely labile blood pressure. In the past the diagnosis of suspected pheochromocytoma was confirmed by the attack which characterized this clinical entity. These attacks were precipitated by various means including physical exertion, change in position, massage of the abdomen on the side of the tumor, immersion of the extremities in cold water or the administration of insulin or of epinephrine. Since none of these methods of inducing attacks is dependable the authors believed that a simple procedure which would induce attacks at will would be of great help in diagnosis. They review the literature dealing with the subject and then give the results

of their own tests in the hunt for a simple procedure which might be used in diagnosing patients with tumors of this sort. Their results are summarized as follows:

An intravenous injection of 0.025 mgm. or 0.05 mgm. of histamine base was given to 51 persons, who were divided into four groups as follows: group 1, normal persons whose ages ranged from 20 to 48 years; group 2, hyperreactors to the cold pressor test whose ages ranged from 19 to 50 years; group 3, patients who had well established hypertension and whose ages ranged from 35 to 63 years; and group 4, patients suspected of having pheochromocytoma whose ages ranged from 39 to 50 years.

In the first three groups the blood pressure rose to a level somewhat less than the elevation obtained by the cold pressor test. Except for flushing of the face with subsequent headache, which was most intense in the patients with severest hypertension and pronounced tachycardia, no other symptoms were present. The results of the test were regarded as negative. In 1 instance typical histamine cephalgia was produced by this amount of histamine base.

When histamine base was given to 3 patients who had pheochromocytoma, the blood pressure rose approximately to 100 mm. more than the elevation obtained by the cold pressor test. This elevation of blood pressure was accompanied by the characteristic symptoms of a typical spontaneous attack.

Although the number of cases in this series is small, the intravenous injection of small quantities of histamine base may be considered tentatively as a worthwhile test in distinguishing the syndrome of pheochromocytoma from other clinical conditions.

PAUL MERRILL, M.D.

Duffield T. J., and Jacobson, P. H.: Cancer Mortality and Marital Status; an Analysis of Deaths Attributed to Cancer among the White Population of New York City during 1929-41. *J. Nat. Cancer Inst.* 945 6 03

During the years from 1939 to 1941 the recorded number of deaths from cancer in the white population of New York, New York (15 years of age or over) was 34,019. These deaths were distributed by sex as follows: single males, 3,393; single females, 2,255; other males, 15,011; other females, 14,459.

Using these figures and data in regard to the marital status of the population from the 1940 census the authors were able to draw the following conclusions from the study of various types of cancer:

1. In cancer of the breast the death rate among single women at ages over fifteen years was more than 1½ times that of other women. Between the ages of 15 and 34 years the rate among the married women was about one third higher than that among the single women, but at all ages over 34 years the single women had higher death rates. Between the ages of 45 and 54 the rate for unmarried women was 79 per cent higher than that for married women.

2. The mortality rate from cancer of the uterus was 25 per cent higher among married women than

among single women. Between the ages of 35 and 74 however the rates were apparently equal.

3. In cancer of other female genital organs the death rate was 41 per cent higher in single women than in other women.

4. For all ages over 15 years the death rate from cancer of the genitourinary organs in males was about equal in the married and unmarried groups. Between the ages of 45 and 54 the mortality rate among single men was 50 per cent higher than among married men, but it was found to be 25 per cent lower between the ages of 65 and 74.

5. At all ages over 15 years the mortality rate from cancer of the buccal cavity was 73 per cent higher in single men than in married men. The mortality rate was six times as great among men as opposed to women.

6. In cancer of the stomach the mortality rate was 20 per cent higher among married women than among spinsters. The difference among the males was not considered significant except after the age of 75 years when the rate for single men appeared to be lower.

7. In cancer of the peritoneum and other portions of the digestive tract there was no significant difference between married and unmarried women. The rate for married males was 11 per cent higher than that for bachelors.

8. There were no significant differences between married and unmarried groups in carcinoma of the respiratory system.

9. In all other types of cancer (analyzed as one group) in both males and females the rates were higher for single persons. ORLAND B. SCOTT, M.D.

Coller F. A., Job, V., Vaughan, H. H., Kelder, N. B., and Moyer G. A.: Translocation of Fluid Produced by the Intravenous Administration of Isotonic Salt Solutions in Man Postoperatively. *Ann. Surg.* 945, 13 663.

During the past decade, Coller and his collaborators have repeatedly directed attention to the potential toxicity of so-called "physiological saline solution," especially when large amounts are administered. They have emphasized that these dangers are increased manifold during the immediate post-operative period of the sick surgical patient.

Studies to determine the manner in which the human body handles large intravenous infusions of salt solutions were undertaken by the authors in patients undergoing combined abdominopelvic resection for carcinoma of the rectum. An explanation of the salt tolerance was sought in the excretions and retentions of sodium, chloride and water in the 30 hour period beginning with the operation. Solutions of various composition and tonicity were infused at regular intervals during this period.

The patients who served as subjects were selected only in that it was determined that they were free of gross cardiovascular and kidney disease.

The normal kidney is able to concentrate chloride taken orally at the rate of from 0.39 to 0.33 mEq per

milliliter. In spite of heavy salt loads no patient studied by the authors approximated this value. As a result of the increasing salt load and increasing hypertonicity of the extracellular compartment, osmotic relationships can be maintained only by a shift of water from the intracellular to the extracellular space. Loads of salt created by the isotonic solutions require a transfer of approximately 2 liters of intracellular water within 30 hours after operation. The edema, a symptom of postoperative salt intolerance may result not so much from the retention of water with salt as from the shifting of water from the intracellular to the extracellular space. It is unknown how much dehydration the cells can undergo before function breaks down and ceases. The brain cells are especially sensitive to change and the disorientation so often seen in cases of salt intolerance may be a symptom of this fluid shift.

The authors summarize their findings by stating that the injection of isotonic sodium chloride solutions was attended by an average retention of 53 per cent of the sodium, 46 per cent of the chloride and 19 per cent of the water 30 hours after the operation. Such retentions of salt indicate a withdrawal of approximately 2 liters of fluid from the intracellular compartment in order to maintain isotonicity. The infusion of hypotonic solutions resulted in the average retention of 27 per cent of the sodium, 32 per cent of the chloride and 39 per cent of the water during the same postoperative period. Extra water is thereby provided for excretory function of the skin and lungs and the intracellular compartment is not involved.

The human kidney under the conditions of the experiments, did not elect to guard a physiological saline solution.

The authors conclude from their experiments that if intravenous infusion is indicated in the postoperative care of the surgical patient, hypotonic solutions (0.45 per cent sodium chloride or better 0.38 per cent sodium chloride plus 0.11 per cent sodium bicarbonate) should replace the isotonic solutions commonly in use.

JOSEPH K. NARAT, M.D.

GENERAL BACTERIAL, PROTOZOAN AND PARASITIC INFECTIONS

Robenstein A. D., Tabershaw I. R. and Daniels, J.: Pseudo Gas Gangrene of the Hand. *J Am M Ass* 1945 129 659

Three cases of a new syndrome characterized by the rapid appearance of subcutaneous gas tumor masses within a few minutes after a superficial laceration of the hand occurred in 2 plants, where an alloy composed of 90 per cent magnesium was being used. Each patient had handled this material in a finely powdered form prior to the occurrence of the injury. It is possible therefore that an etiological relationship exists between the alloy and the syndrome.

Because this syndrome may simulate gas gangrene, it is important that its clinical characteristics

be borne in mind in order that unnecessary surgical procedures may be avoided. The syndrome is characterized by a rapidly developing swelling of a superficially injured part with crepitation and with an almost insignificant constitutional reaction.

SAMUEL KAHN, M.D.

Anderson D. G. and Jewell, M.: The Absorption, Excretion and Toxicity of Streptomycin in Man. *N Engl J M*, 1945 233 485

After oral administration, streptomycin is not absorbed in amounts sufficient to produce detectable concentrations of the drug in the serum. The failure of the drug to be absorbed from the gastrointestinal tract is not due to the inactivation of the streptomycin by the gastric juice.

After intramuscular or intravenous injection of a given amount of streptomycin, the curves of the serum concentration of the drug do not differ significantly except during the first few minutes after injection. Following the intramuscular or intravenous administration of a single dose of streptomycin, from 46 to 87 per cent of the dose injected can be recovered in the urine within 24 hours.

Streptomycin is excreted more slowly by the kidneys than is penicillin. It appears likely that effective blood levels of streptomycin can be maintained by administering the drug at intervals of from 6 to 8 hours.

The intrathecal administration of streptomycin in doses up to 20,000 units does not produce signs of meningeal irritation. With doses of from 10,000 to 20,000 units an appreciable concentration of the drug can be maintained in the cerebrospinal fluid for at least 24 hours.

No serious toxic reactions follow the injection of single doses of streptomycin in amounts up to 600,000 units or after the continued administration of the drug for periods of from 2 to 3 weeks, in doses totaling from 2,725,000 to 18,150,000 units. The intravenous and subcutaneous injections of concentrated solutions of the present preparations of streptomycin cause too much discomfort to warrant the use of these methods of administration. The drug can however be administered in an intravenous infusion without the production of unpleasant symptoms. Intramuscular injections are fairly well tolerated for periods of from one to two weeks. Therapy continued beyond this time may cause severe discomfort.

Three cases of infection due to a gram negative bacillus, and treated with streptomycin are reported. No conclusions concerning the efficacy of streptomycin can be drawn from them.

SAMUEL KAHN, M.D.

Hellman D. H., Hellman F. R., Hinshaw H. C., Nichols, D. R. and Herrall W. E.: Streptomycin: Absorption, Diffusion, Excretion and Toxicity. *Am J M Sc*, 1945 210 576

Streptomycin was administered by continuous intravenous drip so that some patients received as

TABLE I—CONCENTRATIONS OF STREPTOMYCIN IN BLOOD SERUM FOLLOWING REPEATED INJECTIONS

Case	Administration of streptomycin			Streptomycin in blood serum (units per ml)					Method of assay	Reaction
	Route	Dose every 3 hr (units)	No. doses	12 hours after first dose						
					3	6				
	I V I	100,000	3	3	5	1	3	5	Slide cell	None
				3.4	0	3	3	3	Cup plate	
	I V	100,000	3	3	5	5	5	5	Slide cell	None
				4.0	3		3.4	6	Cup plate	
3	I M I	100,000	1	3	5	5	5		Slide cell	None
				7	6	6	3.3		Cup plate	
	I M	100,000	3	1	5		3	5	Slide cell	None
				3	3		3	3	Cup plate	
5	I M	400,000	1	1	3		3	3	Slide cell	None
				6			3.0	3	Cup plate	
6	I M	400,000	3				3		Slide cell	None
				5.7	1	3.3	6		Cup plate	
	I V	400,000	1	1	0		7.1		Cup plate	Just pain, fever, no assay, later in serum, later burst.

TABLE II—STREPTOMYCIN IN CEREBROSPINAL FLUID

Case	Route of admin.	Dose (units)	Doses per day	Concentration in blood serum (units per ml)				Concentration in cerebrospinal fluid (units per ml)			
				12 hours after injection				12 hours after injection			
				3			3	3		6	6
	Intrathecal	20,000								20	5
		200,000								6	
	Subcut.	20,000	3					None detectable			
		50,000	6		3	3	3				
	I M	50,000	3		3	3	3				
1	Subcut.	100,000			5	6	6	3			
6	Subcut.	200,000			6	6	6	6			

TABLE III—EXCRETION OF STREPTOMYCIN IN BILE

Administration of streptomycin			Day	Hours after first dose	Concentration in blood serum (units per ml)	Concentration in bile (units per ml)	Total in 24 hours (units)
Route	Dose every 3 hr (units)	Doses per day					
Subcut.	100,000	6			6	5	
					6	17.5	none
Subcut.	100,000	3				6	none
Subcut.	20,000	3	3			3	none

much as four million units per day. The streptomycin unit was that quantity of dry material which inhibited the growth of a strain of *Escherichia coli* in 1 c.c. of nutrient broth or agar.

In a patient receiving two million units of streptomycin daily, the blood was found to contain 31 units per cubic centimeter of the antibiotic. The intravenous administration of streptomycin was not attended by severe thrombosis of subcutaneous irritation when infiltrated. Intermittent intravenous administration resulted in a high concentration of streptomycin which then fell rapidly. Intermittent intramuscular injection appeared to be the method of choice because effective concentrations were present in the blood for from 3 to 6 hours. A high potency such as 100,000 units can be given readily in 1 c.c. of normal saline solution. Subcutaneous administration of streptomycin also maintained effective concentrations in the blood. Intrathecal single injections of 100,000 units were given for meningitis without any serious reactions and with significant concentrations of the antibiotic for as long as 24 hours. The nebulization of streptomycin for tracheobronchial pathology for a period of 4 weeks at 100,000 units per day caused no serious reactions. The oral administration of streptomycin at 125,000 units every 6 hours caused a significant reduction in *Escherichia coli* in the bacterial intestinal flora and was not followed by any absorption into the blood stream. Diffusion of streptomycin into the cerebrospinal fluid did not take place except when large doses were given parentally during meningitis. Placental transmission of streptomycin from the maternal blood stream to the fetus occurred readily after parenteral administration. Streptomycin was twice as concentrated in the biliary system as its average concentration in the blood. Liver function was not impaired by this antibiotic as evidenced by the normal values of bile and bile salts. From one half to three fourths of the streptomycin was excreted in the urine in 24 hours.

Toxic reactions to streptomycin were rare but may be manifested by chills and fever, generalized flushing, toxic erythema, urticaria, and joint pains. Streptomycin did not appear to have any effect on the hemolytic system. As a rule streptomycin did not impair renal function except when extremely large amounts were given, as a result of which there was evidence of temporary renal irritation.

BENJAMIN G. F. SHAROVITZ, M.D.

DUCTLESS GLANDS

Gabrielson, J. L., Kert, M. J., and Soffer, L. J. The Use of Thiouracil in the Treatment of Patients with Hyperthyroidism. *Ann Int Med* 1945 23: 537

Thiouracil was used in the treatment of 54 patients of whom 51 had hyperthyroidism and 3 had toxic goiter. Thirty-three of the patients were treated successfully with thiouracil for varying

periods of time, the longest period of continuous therapy being 10 months. Four of the patients had recurrent hyperthyroidism, and the remainder had diffuse hyperplasia or toxic nodular goiter.

Three patients with hyperthyroidism were successfully prepared for operation with thiouracil, but 4 patients with hyperthyroidism failed to respond satisfactorily to thiouracil. The latter were subsequently prepared with iodine and successfully operated on. In 11 instances thiouracil therapy was discontinued because of severe toxic reactions.

The following toxic reactions were encountered: conjunctivitis in 5 cases, edema in 1 case, drug fever in 4 cases, leucopenia in 1 case, and agranulocytosis in 6 cases. Some sort of toxic reaction was found in 31 per cent. The development of agranulocytosis or drug fever are indications for the cessation of therapy. Treatment may be safely continued in the presence of conjunctivitis.

Studies of liver and kidney function throughout the course of treatment failed to demonstrate any evidence of injury to these organs resulting from the thiouracil. However, instances of toxic hepatitis occurring during thiouracil therapy have been reported.

Because of the frequency and severity of the toxic reactions, thiouracil should be used under the following circumstances: (1) in the preparation of iodine-fast patients for operation; (2) in older individuals with hyperthyroidism, in whom operation is dangerous; and (3) in patients with recurrent hyperthyroidism who have been operated on twice or more.

SAMUEL KAND, M.D.

SURGICAL PATHOLOGY AND DIAGNOSIS

Stewart, F. W., Foote, F. W., and Becker, W. P. Mucoepidermoid Tumors of the Salivary Glands. *Ann Surg* 1945 122: 820

The authors for many years have been interested in a group of salivary gland tumors different structurally from the commonly recognized tumors of this type. They were unable to find adequate clinical and pathological descriptions of these tumors and were in doubt as to their terminology, histogenesis and prognosis. Gradually by correlating the histological structure and clinical course it was possible to distinguish two structural types, one capable of localized growth and the other of metastasizing. The term "mucoepidermoid" salivary gland tumor expresses two of the principle histological features. The authors believe these tumors represent a little more than 5 per cent of all combined major and minor salivary gland tumors and they deserve more prominence than they now possess.

As a group these tumors show a broad range of histological variation depending on the relative proportions of different cell elements which are present and tendencies to ward diffuse overgrowth by a single cell type. There is no gross uniformity; some are cystic, some solid, some encapsulated, others not. Recurrences may be structurally different

from the primary growth. It is likely that many of these tumors have been classified as cystadenomas, basalomas, cylindroma, adenocarcinomas or so-called mixed tumors.

The authors then list a number of cases in the literature which may be tumors of this classification. They believe that this group has been dealt with sparingly in the literature and is a group which is unfamiliar to many experienced pathologists.

The material for this analysis was obtained from the records of the Memorial Hospital, New York, New York, pertaining to approximately 700 major and minor salivary gland tumors of all types observed between 1925 and 1933. Of this series 45 cases were classified as mucocystic tumors. All of these contained mucous cells and cells with epidermoid qualities.

All evidence in this material points to the salivary gland ducts as the anatomic site of origin of mucocystic tumors. These tumors can be separated into two histological types—benign and malignant. The term benign as used here does not necessarily imply innocent behavior but does mean that thus far the authors have not observed metastases from these tumors. Malignant means a histological structure associated with the ability to force regional nodes and distant metastases.

In 14 of the 26 benign tumors the predominant cells were epidermoid in 9 they were mucous and in 5 they were basal. At least three cell types were represented in the majority and the presence of multiple cell types in large numbers was more characteristic of benign than of malignant tumors. In a restricted area, the pattern depends on the predominant cell type. If basal or intermediate cells predominate a uniform mosaic result with sheetlike groups of varying sizes, the peripheral margins of which are sharply delineated as seen in a basal cell epithelioma or a sweat gland adenoma.

In areas of mucous cells, one sees instead quite small or even greatly dilated ductlike structures which are lined by one or several cell layers. Some of these areas assume papillary qualities and not infrequently possess a central core of vascularized fibrous tissue. In some of the ductlike or cystic areas are found "mucus pools" which stain brilliant red with Mayer's mucicarmine. If there is overproduction of mucus, dilatation ensues with erosion of the lining epithelium, disruption of the basement membrane and leakage into the adjacent tissue. This may result in necrosis or a marked secondary inflammatory process with an associated foreign body reaction with multinucleated giant cells.

In foci of epidermoid cells, it is unusual to find complete dissociation from basal or intermediate cells, and when the cells assume squamous qualities there is apt to be a diffuse intercellular overgrowth. These cells are similar in size and shape, their staining qualities are uniform and mitoses are few. One is apt to regard the tumor as malignant until greater familiarity with its structure is obtained. About one third of the benign tumors showed certain

areas composed of cells hydropic and swollen cells similar to the clear cells of a renal adenocarcinoma. One may assume that these cells contain mucus but none takes the mucicarmine stain.

In 14 of the 19 malignant tumors, epidermoid cells were predominant and in only 5 were mucous cells even second most frequent. By epidermoid cells is meant cells similar to basal cell carcinoma and squamous cells without intercellular bridges and keratohyaline granules. Intermediate cells, slightly larger than a basal cell and with more vesicular nuclei and more abundant cytoplasm, were a frequent cellular component of these malignant tumors. Columnar cells were rare. True squamous cells with intercellular bridges and keratohyaline granules were found in 5 cases.

The outstanding characteristics of these malignant tumors is a diffuse proliferation of rather small, moderately hyperchromatic, rounded and oval cells in sheetlike arrangement with a tendency toward palisading at the outer layer surrounding the proliferating sheets and pegs of the tumor. The impression is one of a basal cell epithelioma with one thing added, and there is an appreciable resemblance to the transitional cell carcinomas of other locations.

Malignant tumors show little tendency to form microcysts. Tubular and papillary features are infrequent and mucus pools practically nonexistent. The histological structure of metastases sharply reflects the variable structure of the primary lesion. Mucous cells were found in metastases in 5 cases.

The 14 primary and 9 recurrent benign tumors varied in size from 4 mm. to 4 cm. in diameter, averaging between 2 and 3 cm. They were oval in shape and well circumscribed, usually with a poor capsule. Usually these tumors were moderately firm but not indurated. A majority were at least partly cystic and contained nearly clear opalescent or blood stained mucoid material, usually viscid. The nearly solid tumors were grayish white or grayish pink but not lobulated. About one-half of the tumors showed discoloration due to secondary hemorrhage and/or necrosis.

Of the 19 malignant tumors, only 10 were excised (4 primary and 6 recurrent). The majority were between 2 and 3 cm. in size and the largest 5 cm. Lack of encapsulation was a distinct feature and most of them were obviously infiltrative. There was much less cyst formation than in the benign tumors, and none showed grossly visible mucus aggregates. They were distinctly firm cellular, opaque grayish-pink, and homogeneous with fairly common hemorrhage and necrosis.

A study of the ages of the patients at the onset of their symptoms shows a general trend for the benign tumors to occur in a younger age group. Forty-two per cent of the benign tumors occurred in patients more than 40 years of age and 65 per cent of the malignant tumors occurred after this age. None of the benign tumors occurred after 60 years of age, but one fourth of the malignant tumors first gave symptoms after this age.

The parotid salivary glands were the most common sites of both benign and malignant mucoepithelioid tumors, the majority being benign. The other major salivary glands were involved only exceptionally. Nearly one third of the tumors (mostly malignant) occurred in the minor salivary glands in a variety of locations.

Painless swelling was the outstanding symptom in the benign series. Slow growth and absence of involvement of the facial nerve were commonly reported. Several patients had local pain or bloody sputum and 3 cases were found on routine physical examinations. There was a wide fluctuation in the duration of symptoms. Nine patients had symptoms for a year or more and several had had them for five years.

The syndrome was far more varied for the 19 malignant tumors. This was largely due to their location within the oral and nasal cavities and the more aggressive growth of these tumors. Eight patients (42%) reported a painless swelling as the original symptom. Three noted painful swelling. Others complained of nosebleed, a mass, lacrimation or a nasal discharge. One patient first noted a metastatic lump in his neck. Other symptoms which occurred during some phase of the disease were numbness of one side of the tongue, interference with speech, dryness of the mouth and sore throat. Lacrimation, trismus and facial nerve weakness were seen in 1 case. Pain was a prominent symptom in most cases sooner or later. Three of these cases gave a history of cachexia and weight loss. About one half of the patients reported a rapid increase in size of the mass.

Six of 10 patients had symptoms for less than one year. Two cases are presented as evidence of the transformation of benign into malignant tumors.

The benign tumors, whether recurrent or not, were nearly all described as firm. An occasional one was elastic or rubbery and only 2 were considered cystic. Most of the tumors were well defined but not as sharply as the so-called mixed tumors. Five of the 50 parotid tumors were firmly fixed and several others had infiltrated the skin. All of the primary tumors were single but 2 of the recurrent cases showed multiple discrete nodules. The 5 benign tumors of the minor salivary glands were submucosal except for 1 polypoid nasal tumor. Two of these tumors had ulcerated through the mucosa.

The malignant tumors, whether primary or recurrent, were firm, fixed, poorly circumscribed and infiltrative. Both submaxillary tumors fungated through the skin. One parotid tumor interfered with the facial nerve. All but 2 of the minor salivary gland tumors showed mucosal ulceration. The intraoral and intranasal tumors were complicated by erosion and penetration of adjacent bony structures.

In 11 of the 36 benign cases the tumors had recurred after surgery when first seen by the authors (5 of the 11 were twice recurrent). Late recurrence may be characteristic of these tumors. Ten of the recurrent tumors were parotid and 1 nasal.

Of the 19 malignant cases 9 were recurrent after surgery when first seen, (5 of the 9 patients had more than 1 re-excision). Rapid recurrence was much more likely in this group. Ten patients on initial examination showed clinical evidence of metastases to the cervical or supraclavicular lymph nodes. In 4 of the 10 cases the primary tumor was in the major salivary glands.

Distant metastases were seen in the cervical mediastinal para-aortic and iliac lymph nodes in the lungs, pleurae, myocardium and liver and in the subcutaneous regions of the face, scalp, axilla and abdomen.

In 14 of the cases of benign tumor treatment was started more than 5 years ago. Three have been lost to follow up and were free of disease 1, 2 and 2½ years respectively when lost. Nine patients were alive and free of disease, and 3 had recurrences which are probably inoperable. Two of the 5 year cures were from irradiation alone and 3 followed surgical excision alone. Four of the 9 cases were subjected to combined surgical excision and radiation treatment. Radon seeds were implanted in the operative area in each case. One case received additional external irradiation also.

The highly fatal character of the malignant group is shown by the fact that 7 patients are dead, surviving 2, 3, 5, 8 and 9 months and 2 and 10 years after treatment respectively. Five of these 7 patients had clinical or pathological evidence of metastases when treatment was begun. Twelve patients are living, 2 have locally uncontrolled tumors and 1 has subcutaneous metastases. One patient alone is alive and free of tumor after 5 years. Two are living 3½ and 2 years respectively and believed to be free of tumor. The follow up period in the remaining 8 still living is too short for significant comment.

ROBERT R. BULLOW, M.D.

Hinton, J. W., and Lord, J. W., Jr. Surgery in Toxic and Nontoxic Nodular Goiter. *J. Am. M. Ass.* 1945 139 605.

All nontoxic nodular goiters should be removed surgically because of the relatively high incidence of unsuspected cancer.

Thiouracil is contraindicated in the treatment of toxic nodular goiter and operative intervention is the treatment of choice. JONES J. MALONEY, M.D.

EXPERIMENTAL SURGERY

Thompson, S. A., and Pollock, B.: The Use of Free Omental Grafts in the Thorax. An Experimental Study. *Am. J. Surg.* 1945 70 227.

Free omental grafts when applied to such thoracic structures as the pleura, the cut surface and edge of the lung, the bronchus, the esophagus, the aorta, and the vena cava, became adherent and viable in a large percentage (95%) of the experimental animals. Four of the grafts in the series failed to take. Three of the graft failures occurred in autogenous grafts and 1 in a homologous graft. In 2 of the failures the graft

INTERNATIONAL ABSTRACT OF SURGERY

acacia. These animals survived 4 exploratory laparotomies with biopsy of the liver and remained in good condition. These results assured acacia therapeutically when careful management is assured.

licity of the mold medium from which the filtrate was made
SAMUEL KAMR, M.D.

Gey, G. O., Gey M. K., Inul, F., and Tedder H. J.
The Effects of Crude and Purified Penicillin on Continuous Cultures of Normal and Malignant Cells. *Bull. Job. & H. J.* 11 19 1935 77 110

Continuous cultures of normal (rat) and tumor (human rabbit and rat) cells maintained in roller tubes as pure strains tolerate very high concentrations of penicillin sodium for very long periods of time.

It is possible to cultivate almost indefinitely strains of cells in plasma culture media with supernatant fluid containing penicillin sodium in concentrations of 5,000 Oxford units per cubic centimeter. Such successful cultivation apparently depends upon the character of the immediate cultural environment as well as upon the inherent tolerance of the cell strain.

No conclusive evidence of an increased tumor cell susceptibility to purified penicillin, when compared to that of normal cells, can be drawn from the results obtained on continuous cultures and on primary explants of tumors produced by the inoculation of continuous cultures of tumor cells into animals. The toxicity of crude penicillin filtrate is much greater than that of the therapeutic penicillin sodium and is perhaps due in large part to the toxicity of the mold medium from which the filtrate was made.

HOSPITALS; MEDICAL EDUCATION AND HISTORY

McGill, C. M.: Hernias and Serious Injuries. *J. Am. M. Ass.* 1945 139 673

The author demonstrates the value of preplacement physical examinations in industry by comparing data from five shipyards which conducted preplacement examinations with those from five yards which did not. The average employment of each group exceeded 100,000.

Accident frequency records showed no significant difference. The quarterly loss ratios or the ratio of incurred expense (including incurred indemnity and medical losses) to the total compensation insurance premiums was also studied. The mean loss ratio for the five yards conducting examinations was 37.13 as compared to 48.01 in the other five yards, which indicated costlier and more serious accidents in the latter.

It was not possible because of the variation in workmen's compensation laws to compare the two groups on the basis of total compensation expense. The average of serious cases and hernias per month per 1,000 employees, however, shows that the rate for hernias is over three times as high, and for serious injuries almost three times as high in the yard which did not conduct preplacement examinations as the corresponding ratio in the yard that did conduct such examinations.

ORLAND B. SCOTT, M.D.

SURGERY

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'HITS STRIKES AND OUTS IN THE USE OF PEDICLE FLAPS FOR NASAL RESTORATION OR CORRECTION

VILRAY P. BLAIR, M.D. F.A.C.S. and LOUIS T. BYARS, M.D. F.A.C.S. St. Louis, Missouri

THE purpose of this paper¹ is to illustrate some of the underlying factors that can make either for success or for failure in the substitution of skin bearing flaps for lost or lacking nasal tissue. Such flaps may be used alone or supplemented with cartilage implants or free skin grafts. The need for nasal restorations or corrections might come from (1) congenital absence (total or partial) (2) postnatal growth irregularities (3) tissue loss through disease accident or surgical destruction.

PREOPERATIVE CONSIDERATIONS

The quality of final outcome and number of operative steps required may be more closely related to the thoroughness of preoperative study and planning than to the skill expended. In complex cases it is worth while to check repeatedly the tentative plan otherwise some oversight might necessitate a midstream modification causing delay increased operative steps and ultimate disappointment. Disappointment is not helped by the feeling that

more persistent preoperative study might have prevented the debacle.

This survey should compass not only the tissues of the external nose proper and the sources and kind of repair material available but also the condition of the foundation tissues (Figs 7 11 18 26) and of the nasal passages (Figs 5 8 9 15). The latter is unfortunately often missed. Fitness and fit are as essential here as in the foundation of a house. The proper time for securing these is before and not after the nose or the house is added. Therefore before considering the external nasal repair the underpinnings breathing space and the usable nasal remnants should receive careful scrutiny. Loss or displacement in the nasal framework or of the related cheek lip columella or septum should also be determined (Figs 5 and 16). When present correction of such loss or displacement should be at least visualized before the nasal repair is planned. Restoration of the foundation and repositioning of tissues to give breathing space are parts of one problem selection patterning and transplantation of repair material are parts of another problem. These two must at least be correlated mentally before surgery is undertaken.

Recorded sculptors of less skill than Phidias all preferred to materialize their ideas in clay before making a false cut on a marble block.

¹Presented before the American Association of Plastic and Reconstructive Surgery, October 7, 1945.
Bernard G. Sarnat, M.D., assisted in assembling the material for the case histories.

For camouflage and emphasis the greatly reduced prints in the figures have been appropriately blanked and pencilled but without intentional sacrifice of lines of verity.

²This study is based on selections from considerably more than a hundred flap restorations.

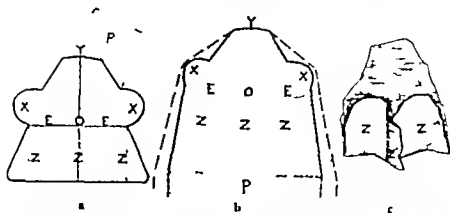


Fig. 2. Diagram of a forehead flap. Z, Z' for vestibular lining and columella. Lateral dashed lines (Z, Z') on the lower part show the minimum width of forehead flap for vestibular folding. Dark outline shows desirable width, often available in men with receding hairlines. Making dorsal covering and vestibular infoldings with adequate airway from forehead flap less than 5 centimeters wide can be difficult. 1. ala. 2. tip of nose. 3. glabella. P. pedicle.

b. Diagram and plan for infraorbital flap, whether arm or body applicable here. sufficient bone or cartilage remains to give form to the new nose (Fig. 18). Observation of graft lined flaps suggests that with no supporting framework a alar flap, patterned after the outer dashed line of b, the covering part, prevails and thinned and lined with contractile split skin graft should fall by itself into form when utilized as a fixed bed. Later the excess graft lining the vestibular part will be removed to accommodate the infoldings. Whether neck, trunk or arm, the pedicle comes from below. Note greater allowance for length of Z, Z'. The pedicle infoldings part of the flap should be between 2 and 3 cm across. (c b).

Diagram for a full model of the plan of the vestibular fold regardless of whether the pedicle is above or below. Z, Z' show the part of the infold used for vestibular lining. Z' the mesial element from which the columella was made.

RESULTS. A. GROWTH OF NOSE WITH SPLITTED FLAPS.

In this series of cases, teen age or younger, some useful comparisons can be made of growth changes in early repair. Disregarding the disparity of ages, an apt comparison can be made between the case in Figure 2 and that in Figure 3. Though the noses were small, the former, as repaired with a forehead flap and the latter with an arm flap.

The relation of size to growth of a nose made with a forehead flap will remain more stable and with an arm or sublabial flap will be rather stable if the major part of the supporting structures has persisted intact. Figure 4 presents a case in which the estimated allowance for growth proved insufficient.

In growing nose with vestibular lining and covering derived from foldings of the same flap, the similar growth impulse may in time cause critical wrinkling of the confined lining layer as can be seen by comparing Figure 5 with Figure 3 where repair was made from an arm flap. This was less evident of the forehead flap repair in Figure 2, as shown by the photographs taken 3 years after final operation in each case.

In Figure 5 repaired with forehead flap, done 1 1/2 months later age the disproportionate changes with growth are less evident. At no stage was there wrinkling of the vestibular lining. Figure 5 shows also that even in the use of forehead flap, it is necessary to make allowance for some shrinkage emphasized by the change in shape of the ala and tip in 3 weeks' time (compare g with h).

Regarding the cases in Figures 6, 7 and 8, sublabial infection, the common characteristics of development of the upper lip, the common characteristics of ulceration in the lip. In Figure 6, as made with infection of the nose or cartilage.

but allowance as made for growth and possible bony core-implantation. This accounts for the marked dorsal convexity of the completed nose. Figure 7 the child originally had almost no supporting framework, lacking even columella and premaxilla. Figure 8 the restoration of the nose closely bound up with that of the lower lip.

Fig. 3. A girl, 10 1/2 years old, with destruction following surface radium applied at 5 weeks of age. Condition shown in a and b. Primary application of a forehead flap. The foldings for ala and columella were shown and readjusted shortly afterward to give better breathing space. c and d. Photographs sent to us approximately 4 years after application and adjustment of the flaps. Comparing with Figure 2, it is shown that the right ala border has become lower than the left, but this could, even now, be readjusted. Seven operative steps, major or minor, were required over period of 3 years.

Fig. 3. A girl, 5 years old, had received destructive radiation in infancy and, in condition shown in a and b. Condition 4 months after surfacing the nose and restoring the vestibule with an upper arm flap c and d. Photographs taken approximately 4 years after final adjustments.

It is difficult at this time to determine whether all of the shortening shown in Figure 3 is real or partially due to some upthrusting in the pose of the photograph that was sent to us.

Five operative steps, major or minor, were done in less than 2 years.

Fig. 4. This supernumerary child was 8 years old when repair was initiated. Early arm flap repair failed to keep on third page following.

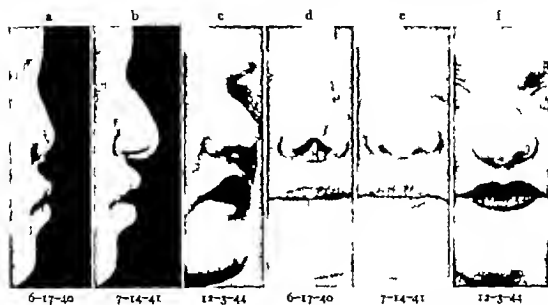


Fig. 2

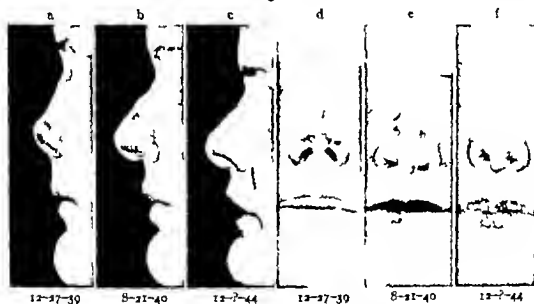


Fig. 3.

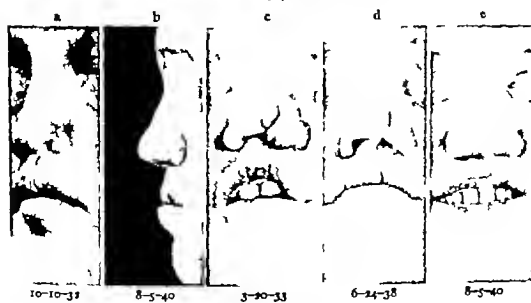


Fig. 4.

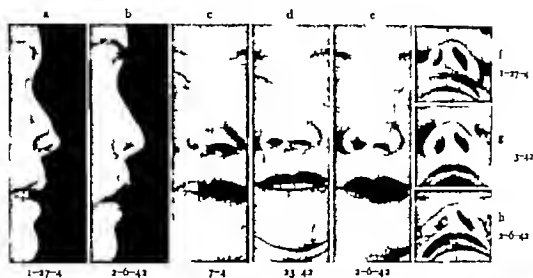


Fig. 5.

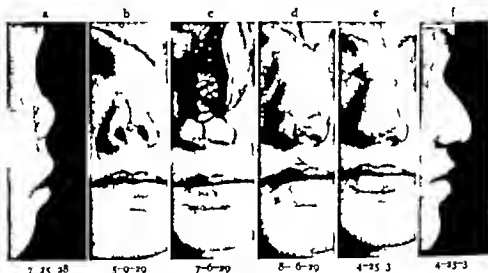
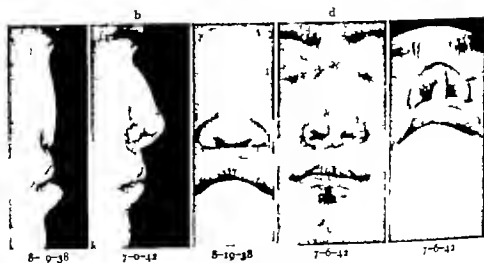


Fig. 6.



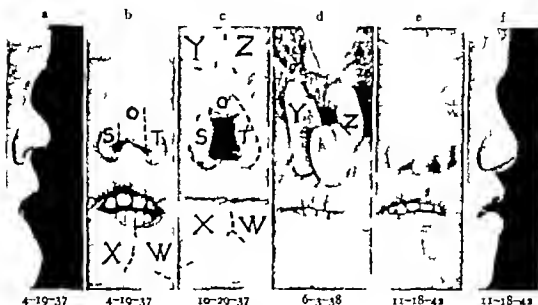


Fig. 8.

pace with nasal growth. a, Shows radium destruction in infancy causing scarring and crumpled ala. c, After excision of damaged tissue, sufficiently extended to insure circulation in the transplant, an oversize flap was implanted in the belief that it would provide for future growth. d, Five years later the above allowance for growth had proved insufficient. At this time the original flap was removed and the distortion was released. An abdominal flap was jumped via the left hand and adjusted. b and e. Photographs taken 2 years after final repair. Twelve operative steps, major or minor, were done over a period of 8 years. The new nose is not central in its relation to the lip or the teeth.

Fig. 5. A girl 17 years old, was injured 9 years previously. a, e and f. Photographs show adjacent partial nose and cheek loss with incidental alar distortion and vestibular block. The skin graft on the upper lip had been applied shortly after injury. d and g. Taken 1 year after covering the right half of the dorsum with a forehead flap infolded to line the vestibule and piece out the ala. The intentional exaggeration of the alar circumference of the vestibule still shows. Gravity was expected eventually to correct the draw-up of the new alar border. b, e and h. Show final adjustment of cheek scar, alar attachment, and symmetrical shrinkage of the alar circumference but the alar border is still above the level of its fellow.

This required eight operative steps, major or minor, over a period of 1 year.

The alar draw up cited persisted.

Fig. 6. Congenital deformity in a girl 10 years old. a and b. Condition at first examination. After release of the uplift, repair was made with a right forehead flap, with a pedicle at the left brow, wide enough to supplement both lining and covering, shown in c. d, The covering part of the flap is in position with a prolongation between the separated ala to piece out the lip. e and f. Last observed result, 3½ years later. This was done in six operative steps, completed in 3 months.

Subsequent growth will likely modify the convexity of the dorsal line.

Fig. 7. Congenital deformity in a girl, aged 12 years. a and c. Show the condition with the lip repaired and a cartilage previously inserted in the upper two-thirds of the dorsum. b, d and e, A flap from the right lower abdominal quadrant was jumped via left wrist to the dorsum after

removal of the nasal covering and the lower part of the original cartilage implant. Later the columella came from an inner lateral palm flap implanted first into the nasal tip and subsequently into the lip. b and e. Owing to circumstantial delays, the 8 major and minor operative steps were spread over a period of 4 years.

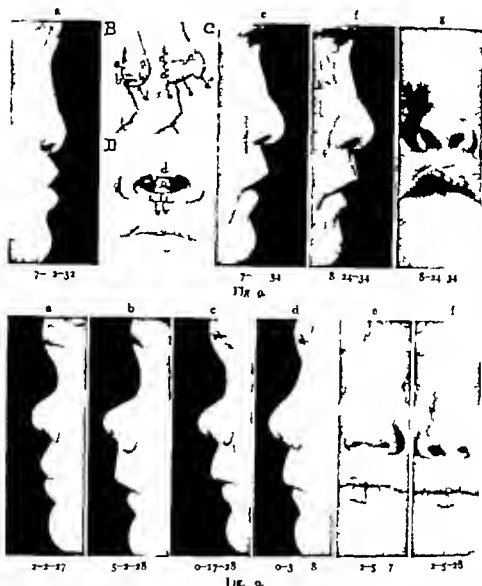
Fig. 8. A girl aged 17 years, with history of premature birth reported weight 1½ pounds. Congenital infection with early ulceration of lips and nasal lining. Left vestibule almost obliterated, columella retracted and much of lower lip missing. a and b. b, The two vertical lines between s and t indicate full thickness incisions which, after discarding the scarred lining and the related cartilaginous septum, permitted the turning in of the skin to furnish attachment to the future lining flaps. s' t' s in c. X and W indicate full thickness flaps (8, b). In c, flaps X' and W' have been rotated to give vertical length to the lip. F and Z indicate primary raising of the nasal flaps. d, The nasal flaps F and Z were again raised, the distal two-thirds of each thinned doubled back and fixed with sutures to heal, raw to raw to help piece out the vestibular lining.

The nose as shown in e and f was accomplished by turning in s' t' s as partial lining, attaching the nasal flaps F and Z sutured in the midline. The columella came from some extra width on the mesial border of Z, originally provided for that purpose. We have several times used this double flap where the forehead was wide but too low to furnish it in one piece (Fig. 3a). The dorsal line of junction can, with careful cutting and suturing, be made all but invisible. Where a nose is patched with an arm flap, the line is apt to be evident, less so if enough material was provided to allow a secondary adjustment.

e and f. Show the final result. At recent steps a crescent piece was sawed from the mandible to shorten the vertical chin-lip length. Later the two halves of the lip were separated. A folded arm flap was implanted into the midpart to give more than double the transverse width of the previously tight lower lip. At the time of transfer the rolled edge was left overfull to permit later an attempted reproduction of the natural slight ridge of the mucocutaneous junction.

This was accomplished in 8 major or minor steps done in 5½ years time.

A wider insert would have avoided the slight "V" at the right border.



SERIES B DEFORMITIES INCIDENTAL TO A SHORT NASAL TUBE

These deformities might be congenital, as in Figure 9, or due to infection, as in Figure 10, or acquired in growth, as in Figure 11. In some, correction might necessitate synchronous lengthening of the nasal covering (Fig. 11).

Fig. 9. a, Girl, aged 1 year, with columella and vestibular floor short, but with full vertical length of the dorsum. Correction required several very distinct steps. The first was accomplished by dividing the short columella from the lip and septum. This stubbin of columella was fixed in an advanced position, shown in b. In b, -a roughly indicates

lining incision that traversed the floor of the vestibule and extended well forward in each lateral wall. b-b indicates the lower border of the ala, d the original position of the columella. c, Wide undermining permitted the border and lower part of the alar covering to be moved downward and forward, with the resulting lateral defect in the lining, indicated by a'-a-a' while the liberated stump of columella was moved forward to d'.

d, The lining defect was filled in with the two halves of a swallow tailed lateral palmar flap, introduced through the nostrils. After circulation was established, the pedicles, ff were divided in the midline of the floor. The columella was later placed out from the remaining palmar pedicle. e, indicates the bare lower border of the septum.

c Show the result of these implantations but which have not as yet brought the nose or lip sufficiently forward. To correct this, the cw columellar patch was freed from the septum, the lips and cheeks were freed from their intranasal attachments by incising in the depth of the upper sulcus, and with the columella were sutured in further advanced position, the circulation in the columellar patch being maintained by its anterior and posterior attachments. f and g Show the final advancements and the columellar patch.

This was done in seven operative steps, which for extrinsic reasons were extended over 2 years.

Fig. 10. A woman, 38 years old, had a flat bridge since childhood with history of ulcerations and repeated treat-

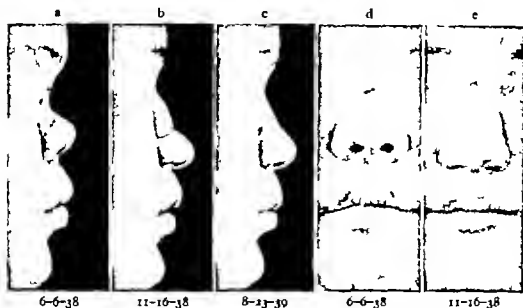


Fig. 1

ments. a and c, Show saddle nose and loss of vestibular lining, but dorsal covering and columella of sufficient length short nasal tube. Disregarding the presence of the columella which was lacking in Figure c, the plan of lengthening of the vestibular floor and walls is identical with the exception that in Figure c, d, the swallow tailed flap was introduced through the common nostril space while in this case it was introduced sublabially.

b, Shows the immediate result of the tubal lengthening which for lack of cartilage support was but partially maintained in the healing process (see c) but a secondary undermining of the dorsum and the implantation of cartilage gave the result shown in d and f. The above procedures give about the limit of lengthening solely by additions to the lining. This was accomplished in 7 operative steps, major or minor, over a period of 15 months.

Fig. 11. Fairly postnatal development with shortening of both the dorsal line and the nasal tube in a man, 21 years old. a and d, Here the approach was through an external incision as indicated by the dashed line in a. The

superficial tissues were stripped as far down as the dotted line, at which level the alar cartilages and floor of the vestibule were cut across. The lower part of the septum and the related soft tissues were mobilized as in Figure 10. In Figure c the lining flaps were entered from below met at the dorsum and were wedge shaped. In this case, the lining flaps entered through the dorsum and met at the midline of the floor were cut across at the dorsum square-ended both above and below. The covering flap in b, came from farther up on the pedicle. Later developing scar constrictions were dealt with through the nostrils the need for the latter is less frequent after implantation of a forehead than of an arm flap. b, Shows the condition several months later c and e. Views of the final result, show the dorsal line brought forward, accomplished by surface readjustment and dorsal implantation of costal cartilage. Four years later always were reported satisfactory. A total of 7 operative steps was done in 1 year's time.

Split graft in forehead could be replaced with pigment injected full thickness graft.

FLAPS

There are three general sources from which the flap might be taken directly or jumped (1) the hair free regions of the forehead and face (2) the arm hand anterolateral areas of the trunk and the groin (3) pedicle flaps derived from the nose (Figs 1 27 and 29) Of prime importance in the selection of tissue for a flap is the recognition of variations in the suitability intrinsic to the donor area. The outstanding characteristic of those taken from above the mandible is quality from below the clavicle is quantity. In hair free areas of the neck those factors merge but with quality still dominant (Fig 17) A more detailed but terse differentiation of aptitude is given in Table I

Human flap material is precious. The surgeon will best serve the patient and himself by first making patterns from plaster-clay restorations of what he is attempting to re-establish (5 a). One that does not exaggerate the surgical possibilities serves as a usable working pattern helps the patient to visualize better the aimed at result, and gives some idea of the intricacies involved. Even then it is hard to gauge the patient's buoyed up expectations. It is good practice to hazard the remark that the operative result will most likely fall quite a bit short of the model—unfortunately often true. In faces both operated upon and not the natural color and mobile expression will camouflage moderate defects in contour which on the white cast stand out glaringly (9)

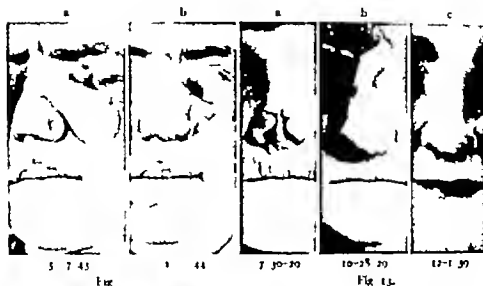


Fig. 13.

Fig. 13.

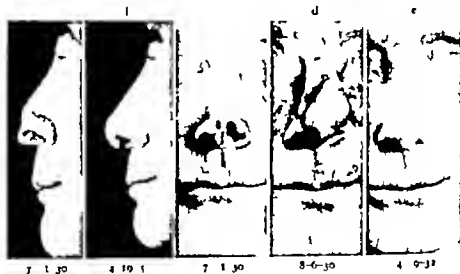


Fig. 14.

REPAIR OF DESTRUCTION IN THE TIP AREA OF THE NOSE

Incisions of this type establishment of breathing space is usually an essential step. The main flap can be taken from the arm, forehead or neck or jumped, like the lining may be supplemented by a flap from the dorsum. Cartilage implantation may be necessary.

Fig. 12. Traumatic loss of tip of nose, 1 month previous. In 1 man 8 years old. a, Flap outlined laterally and undermined but the distal end was not detached. On account of poor circulation, 1 more operative step was required before it was considered safe for transfer. A piece of adhesive covers the missing tip. b, Three more operative steps are necessary. c, It required one. d, Hung, two adjustments and a postauricular skin graft on account of a poor circulation which threatened loss after each operation. This difficulty of establishing circulation is extraordinary for face flap. e, The case. f, Figure 14, the age of the older man may have been factor in permitting the raising and implanting and replacing of the pedicle of the flap at 1 step.

Fig. 13. Not even the age of 3 months and 1½ years, patient had ulcerations of undetermined cause. a, Shows condition at our first examination of the girl, 8 years old. b, Forehead flap was put down in place. This as followed by the usual adjustments. c, Patient returned 10 years later. But no operation was done to bring forward the tip of the nose and split skin graft covers the original lip scars. This required four operative steps in all.

Fig. 14. a and c. Loss of tip of nose from cancer past. In 1 man 32 years old. A triangular flap as raised from the left cheek with the base at the bridge of the nose and was transplanted immediately into the defect. d, It was cut and adjusted pedicle on nose and in back, using skin graft to fill out latter. b and e. Taken 20 months later. This man had a known cryomovable skin with almost no underlying fat which three factors seemed to arrest the necrosis attempt to complete the operation in two operative steps. Compare this with case 1, Figure 2.

There is room for judgment in each case but the success here hardly warrants repetition of the two-step operation.

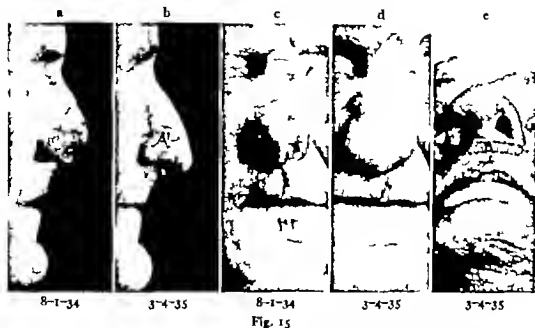


Fig. 15

Fig. 15 a and c, One year after loss of tip and columella narrowing of the vestibular floor and inspiratory collapse with airways obstructed in a man, 40 years old. The repair was made in the standard way from a forehead flap but it lacked intrastitital support. b, The inhalation collapse was controlled by undermining through incisions just within each vestibule, permitting insertion of thin strips of costal cartilage with perichondrium, facing medially to cause a

slight outward bulge. Through incision made at each labial alar junction and undermining, a narrow stiff strip of cartilage was inserted which restored the width of the vestibular floor d and e.

The result was attained in six major and minor steps in 6 months. We have through the same approach put in a single piece of booped cartilage, or a single piece for each side can be inserted through a short dorsal skin incision

Supraclavicular flaps To have the completely made nose of acceptably small size especially upon a woman the part of the flap that will form the alae and tip and be infolded for lining must be made very thin and at least 5 centimeters wide (Figs 16 and 26). This is often not possible on a woman's forehead unless some scalp be included or taken as a bilateral double flap as in Figures 8 and 32. In older men however a receded hairline may become a blessing (Fig. 15) (5 a 8 a).

Face forehead and small neck flaps can ordinarily be safely transferred after two preliminary steps (Fig. 12 was an exception) (1) Make circumferential or both lateral incisions leaving but a small artery-carrying distal pedicle undermine completely but avoid stripping the periosteum (2) After 10 days or longer but only after determining total absence of edema and the efficiency of the proximal blood supply by finger pressure on the distal pedicle divide the latter and suture (Fig. 13).

With a well prepared forehead flap it might be possible and expeditious to thin infold and completely attach the whole nose at one sit

ting. However caution may dictate final thinning of the dorsal part only and temporary adjustment of the infolded part at the time the flap is first brought down. To insure a free vestibular airway without grossly increasing contour secondary drastic thinning of the infolded part will ordinarily be required. The one step thinning and affixing operation is most suitable in making a large nose of an older man where the blood supply is usually generous. For small noses the two-step application is almost mandatory.

A forehead flap with a temporal pedicle is poorly adapted to make a complete nose but can be used for dorsal covering lining (Fig. 6) or patching the cheek (Fig. 23).

Infraclavicular flaps Arm or body flaps should be raised in at least three stages spaced at proper intervals. (1) Make but one lateral incision at a time preferably full length down to the muscular fascia and undermine in that plane more than one half way across the proposed width (2) 10 days to 3 weeks later make the second lateral incision and complete the undermining (3) after a similar interval or longer cut half way or completely across



Fig. 16

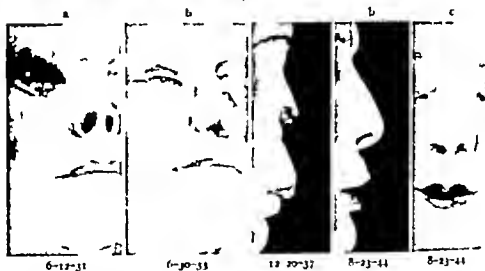


Fig. 17

Fig. 18

Fig. 6. A man, aged 33 years, had been injured in a plane crash. Following this, he had unreduced nasal fracture. Cartilage and ivory implant had been introduced some weeks later. Nose was crumpled, columella retracted and alarway obstructed. a and d, Condition at our first examination. b, Used local anesthesia, the lower lateral cartilages, related mucous lining and vestibular floor scars were removed. The base of the columella was released and flaps of alar skin were implanted in the floor defect, thus advancing and lowering the upper part of the lip and the stub of columella. The lower border of the nasal covering was turned in and sutured; the lining established blood supply for a turn-down lining flap. and e The lip was shortened at its base to expose 4 millimeters of upper teeth. The dorsal covering and the vestibular foldings came from the forehead flap. Five major or minor steps were done in 8 months' time.

Fig. 17. Healed burn from gasol explosion a year previously in man, aged 37 years. Condition at our first examination is shown in a. An outlined upper neck submental, left submaxillary flap, with base at right facial

artery for nasal repair is partially shown by the submental lines in b. Completion of the work. The donor area of the neck was grafted. Incidentally the scarred lower eyelid was released. This and the cheek were grafted. The covering of the right upper eyelid was made from two scarred forehead flaps, the conjunctiva having been sufficiently released. It required 9 operative steps spread over a period of 2 years to restore eyelids and nose.

Fig. 18. a Condition after excision of upper lip, right cheek and nose for greatly distorting lymphangioma, in a woman 24 years old. The soft tissue covering of the nasal bones was turned down to line and stiffen the central part of the nose. The nose was made from the arm with second and third foldings, but after this had healed in place the upper lip and the lower part of the nose were still retracted. To correct this a thicker piece of cartilage than that indicated in Figure 5, but with the same technique, was inserted with the result shown in b and c. At the same time the lip was shortened. b and c Front and side views, respectively, 7 years after repair was begun. This was done in 17 operative steps over a period of 8 years.

DIFFERENTIAL CHARACTERISTICS OF SUPRACLAVICULAR AND INFRACLAVICULAR FLAPS

TABLE 1 —

Flaps taken from face or neck	Flaps taken from trunk or limbs
<i>Inapt</i>	<i>AM</i>
1 Hair free donor areas may be embarrassingly limited especially on the forehead of a woman or the neck of a man	1 Can be made almost any size A. Body hair may be entirely negligible
2 The scar of the donor area is always in sight, though this can be more or less camouflaged by skin graft and intradermal injection of color. Try to avoid a forehead defect on a woman.	2 Most donor sites are hidden by the clothing
	3 Certain of the objectionable factors cited below in the <i>inapt</i> group do not hold true for flaps taken from the front of the wrist or border of the palm. Both are hairless and the latter is of good consistency and color and does not shrink. These latter can be particularly appropriate for certain small repairs such as restoration of a columella or an ala.
<i>AM</i>	<i>Inapt</i>
The forehead flap is intrinsically the more desirable. It is relatively firm in substance with just sufficient elasticity to retain some spring making it self-supporting. When loaded to a sharply molded form it will shrink very little in healing or subsequently.	1 The tissues are relatively flabby and, with the exception noted above unless supported are apt to shrink to an embarrassing extent
2 The constituent layers are rather uniform in thickness and consistency which facilitates symmetry of molding.	2 Such flaps lack definite cleavage planes and closely adjacent areas may vary greatly in skin thickness and in the quality of the underlying tissue all of which tend to negate both symmetry and sharpness of molding.
3 Total blood supply is relatively greater and more easily trained to a narrow pedicle with ordinary precaution. Hesitancy of healing or slough is rare but can happen.	3 The total blood supply will average less, its sources are more diffuse, a greater number of operative steps may be required to establish an efficient pedicle, or even one of doubtful value.
4 The basic blush color will persist or be early restored.	4 In flaps taken from below the clavicle the basic red is deficient or absent however this can be at least partially compensated by suitable injection of color intradermally but will yield no variation in blush.
5 Flaps taken from other nonhair-bearing parts of the face will be about the same qualities but of necessity will be much smaller.	5 The body hair may be negligible or so profuse as to require surgical depilation control with chemical depilatory agents or razor.

the distal pedicle and if circulation warrants the nasal covering part of the flap might be thinned and put up at this time. Never cut across the distal end until the flap has acquired an adequate circulation as proved by pressure test. Venous engorgement can cause gangrene in a pendant flap in spite of a generous blood supply.

At some step the pedicle of a long arm or body flap might be partly or wholly tubed or the raw surface of both pedicle and bed can be covered with split skin grafts at this time except the area to which the excess of pedicle will ultimately be returned. It is desirable in the original planning of a flap to allow for proximal lengthening should a partial loss occur at the distal end (Figs. 30 and 31).

For disproportionately long and narrow flaps on the trunk or neck sectional tubing interrupted by temporarily retained attachments to insure immediate blood supply is a practical plan. These supply bases are later detached and tubed consecutively.

With a forehead flap where the pedicle comes from above a few tacking sutures are sufficient to hold the transplant in place but to compensate for the pedicle drag of a flap brought up from below we use one row of hurried very fine white silk sutures on either side so placed as to give some up-crowding when tied with a superficial row of fine sutures to insure accuracy of skin approximation. With a forehead flap the hurried sutures might be omitted. In either case the superficial sutures are of black silk the knots are not drawn sufficiently tight to leave marks and might be removed in 3 days. These are replaced by a one-layer patch of gauze affixed with flexible collodion. A heavy skin suture deeply placed at the lower end of the alar bulge may be used both to fix and shorten the vertical base of the bulge which will tend ultimately to give a more natural lateral fullness to the ala.

The weight strain is further eased by a gauze strip fixed to the skin with fresh flexible collodion lengthwise to the pedicle below and above to the forehead. If into this traction line a section of elastic rubber band is introduced the lift will be more uniform.

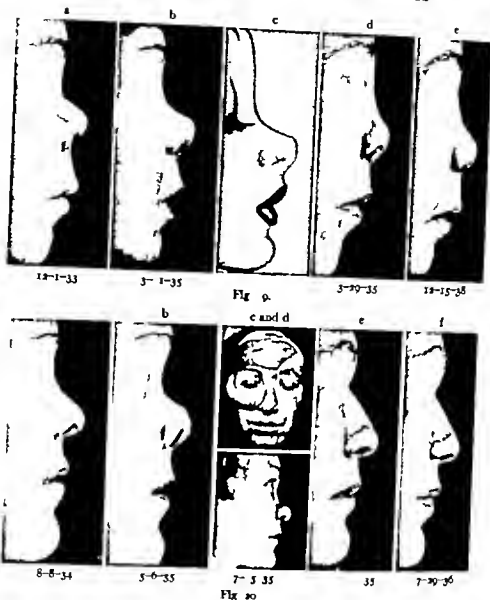


Fig. 20

SERIES D. RESTORATION OF UPPER PART OF NOSE

The cases selected for this and the following series give even greater emphasis to the necessity for exact determination of the real extent of loss or distortion and the mode and possibilities of repair before correction is instituted. Distortion of usable tissue should be entirely released before the flaps are put in place yet the preparation of delayed flaps must usually precede the opening of the bed in which these rest. We have found tape measure, plaster cast of this condition, corrected with modeling clay to be at least a partial solution to the what and the how of this dilemma (see Figs. 9 and 20 and ref. 5-b).

Forehead flaps should be cut very exact. With unrestrained subcuticular flaps, an allowance should be made for shrinkage. An incidental correction as in the case of Figure 3, shows that it may be difficult to estimate how much addition to any eyelid or its foundation will be really needed. Here an overcorrection can be dealt with by simple excision, while secondary additions are apt to be as complicated as the original implantation (Fig. 3).

Fig. 19. Saddlenose: loss of vestibular lining and columella in woman aged 28 years. a, Condition on first examination with scarred lining and a threadlike columella. b, Immediate result of wrist flap implantation used first to vestibular lining after undermining up to the glabella and pulling down the nose. At second step, the pedicle of the wrist flap was used to make the columella. c, Commercial poster exaggeration of type shown in b, which is an acceptable one for certain faces. d, The patient was satisfied and who should have been, but thought further improvements could come by inserting strip of cartilage into the dorsum. This proved to be a minor operation but a major blunder (compare b with d). e, The result obtained after eight subsequent steps, including some actual lengthening of the dorsum. Fourteen operative steps, major or minor, were required over a period of almost 5 years.

The first blunder was not resting in what was satisfactory to the patient. The second was that bringing forward the bridge of that tilted nose upset facial balance. The third was the compromise attempt to steal narrow covering

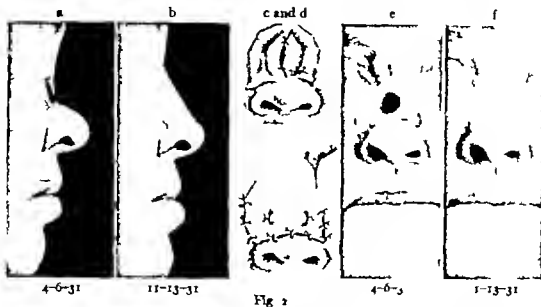


Fig. 2

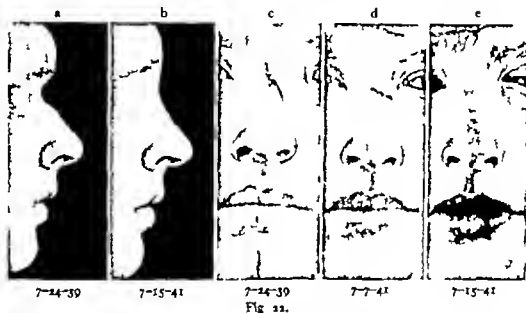


Fig. 3.

and lining flaps from just above the brows in the hope of avoiding a grafted forehead. The flaps obtained were too narrow to give proper length to the dorsum and undermining of the forehead tissues to above the hairline failed to prevent drawing up of the brows. This latter gives an apparent overlengthening to the dorsum of a still turned up nose: a grievous error.

Fig. 30. a, Saddlenose, the result of an unreduced fracture 12 months previously in a woman 20 years old. b, Attempted correction by intranasal chisel-mobilization and wire fixation at first gave promise of being acceptable but with subsidence of the postoperative swelling, the lack of bony fixation, due to too early removal of wire, permitted a progressive distortion, as shown when she returned 6 months later. Adequate fixation for a sufficient period should give union where there is any bony contact. The plan we have used is an interstitial wire loop embracing the nasal spine above and fixed to the maxillary incisions below. This can be retained for 3 months if necessary. c and d, As a secondary attempt, the vestibular portion was completely severed from the bridge by transverse incision, see d. Subsequently the natural dorsal covering was turned in to line

the defect and the whole was covered with a previously prepared forehead flap that had a temporal pedicle shown in d. e, As with our first attempt, the immediate result appeared to be quite satisfactory, but 7 months later the lower part had slipped backward, as seen in a similar case Figure 11. b, f, Final result was further helped by implantation of costal cartilage into both the dorsum and columella. A total of 3 operations with 3 failures due largely to lack of sustained postoperative fixation of the mobilized mass, was required over a period of 2 years.

Fig. 31. a and e, Healed result of extensive cauterization done 3½ years previously on a woman aged 39 years. The dashed marks on e indicate the source of the lining flaps. c, The flap tissues surrounding the defect outlined as in e were undermined, turned in to give a ridged lining to the previously depressed dorsum. The surrounding tissues were further undermined to widen the bed for the covering flap. d, The forehead flap was put in place with the dorsal ridge maintained by temporary mattress suture. b and f, Result shown 6 months after completion of the correction (8, c). In this case 3 operative steps were completed in 7 months time.



Fig. 2.

Small patches of adhesive plaster prevent the cutting in of this necessarily tight mattress suture. Gauze was used for this purpose might cause necrosis.

Fig. 2. A man, 9 years old subglabellar fracture displacement from airplane crash. There were impingement on the nasolacrimal groove, great displacement of the left inner canthus and separation of the lacrimal sac on this side. a, and c. Condition at our first examination 6 months after injury. e. Result obtained by removing displaced bone and supporting sac repositioning of canthus fixed by transnasal 40 day gut suture. Overcorrection will subside after gut absorption. d, The superimposed diagrams indicate the repair flap and also the position of use. The displacement of the right inner canthus as partially corrected at this time by buried suture. b and e, Final result. This required but operative steps with 3 years intervening.

The right inner canthus could have been brought farther medially. The forehead defect was overcome mostly by wide undermining and suture. The remaining uptilt of the inner end of the right brow could be further corrected by a "Z" flap operation, but the patient wished to avoid this additional step. We have seen several such injuries due to rifle wounds in soldiers. If both eyes were intact, the man was grateful for the correction, but where one eye had been destroyed, he was apt to complain of the resulting narrowed visual range of the remaining eye.

Fig. 3. Ulcerations of face, mouth and pharynx, starting 20 years previously in a woman aged 43 years. a and c,

Saddle nose perforation of inner canthus, and loss from the upper part of the cheek, causing a distortion of the lid, extending to the outer canthus. d, A too narrow and too short forehead flap with right temporal pedicle as cut. The distal end was split. The cheek scar had been opened as far as indicated in d, which was not far enough. Nasal lining was obtained from the lower part of this flap. The insufficient upper part but partially filled the defect. Later the pedicle was cut across and returned to the forehead while the medial portion filled in the defect resulting from the letting down of the nose. At this time the remaining raw area was grafted. The tarsus is still not in full contact with the globe. b and e, Final adjustments of the flap. The transverse ridge on the nasal part of the flap, 1 week after final adjustment, is partly swelling and partly an allowance for spontaneous drooping of the nasal tip. b is c, the residual retroption, still so evident in d, has been partially corrected by liberation and insertion of a full thickness graft from behind the ear. This required 7 operative steps, major or minor completed in period of 5 months.

The primary fault here was making the forehead flap too short and too narrow. A longer flap could have permitted opening of the full length of the cheek scar shown in c, and greater width would have brought the tarsal border up to its proper position, thus avoiding the several subsequent steps. Further the supplementary skin graft is also too small, one wider and longer could have compensated for much of both faults.

The use of the inframandibular or infraclavicular flap gives no choice but for at least a two-step operation for affixing the flap attachment and final molding. Only the dorsal attachment with corresponding thinning can be done at the time of transfer. The special thinning for the columella and alar infolding is of necessity postponed until after establishment of the new blood supply and the division of the pedicle (Fig. 31). The vestibule is lined and the columella formed by infolding

of the extra length of the nasal flap already provided for this purpose (Figs. 1 c and 16). In a nose intact above the vestibule any needed lining can usually be derived from the original dorsal covering but in a total restoration an extra flap may be needed (8,a). It may be desirable but more frequently not practical, to make the columellar infolding wide enough from above down to admit later a cartilage transplant to support the rounded tip so common to total noses thus made (Figs. 20, f, 26).

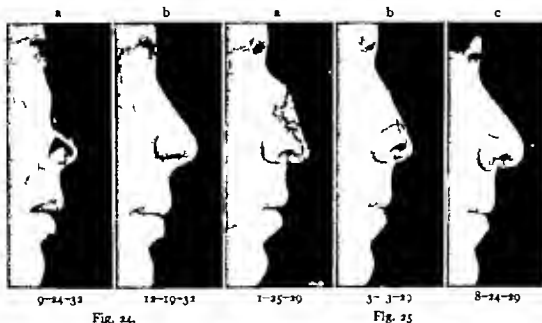


Fig. 24.

Fig. 25.



Fig. 26.

SERIES V. SUBTOTAL RESTORATION OF THE NOSE

Usually a sufficient amount of the nasal framework remains. In certain cases, restoration of the dorsal line can be more easily attained by bone cutting than by cartilage implantation, but both might be used in a given case (Fig. 26).

In all restorations, whether great or small, integrity of the lining is as important as the covering. Restorations after total loss are done on the same lines but an extra nasal flap or graft may be required for lining of floor, dorsum, or both (3c and 8a).

Fig. 24. a, Subtotal destruction of the nose by cancer paste, in a woman 35 years old. b, Result 12 days after repair with forehead flap for covering. The lining came from turning in the remaining dorsal tissue. Repair completed in four operative steps over a period of 3 months.

Here a forehead flap gave a good dorsal line without other support.

Fig. 25. Auto accident caused subtotal loss of bone cartilage and covering in this 17 year old girl. a, A lesser loss than in Figure 24. Note the now too prominent re-

maining part of the bony bridge. b, Result of chiseling off the hump and approximating the bones before transfer of the repair flap. c, Repair with an arm flap. This gives a rounded tip, characteristic of a repair with almost any subclavicular flap (Fig. 17) as distinguished from a forehead flap repair (Figs. 24 and 26). This required 8 operative steps, major or minor, in 6 months.

Fig. 26. Healed subtotal cautery destruction of the external nose: left antral wall, cheek and lower eyelid in a woman, 69 years old. a and b, Repair made with flaps, a, b and c. At intervals, the left forehead flap was sutured into the freshened cheek defect with the mesial edge being turned in also to supplement the nasal lining of that side. At the primary raising of flap c, the lateral incision was made to the bone for right cheek fixation. c In molding the nose, flap c was rotated to pierce out the lining of the left side, b furnished dorsal covering and vestibular infoldings. With the settling of this soft tissue nose there was sinking of the lower part of the dorsal line. In the case in

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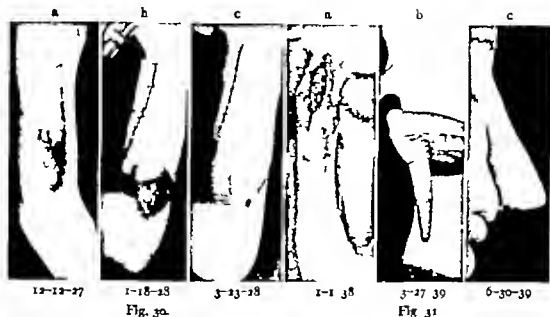


Fig. 30.

Fig. 31.

SERIES C. ARM FLAPS

Given a sufficiently bare area, a forehead flap may be cut to the desired size with little or no allowance for shrinkage (Fig 1 a) but for the arm or body flap (Fig 1 b) there is not only a natural tendency to shrink, for which some allowance should be made but the weight of the pendant pedicle tends to elongate the latter at the expense of width so that what at first appeared to be ample may have to be supplemented or the whole transplant discarded. It is for this reason that we cut an arm flap not only wider than apparently needed but make the pedicle even wider than the lateral extensions for the alae (Fig 7 h). The extra weight also demands more meticulous suture or an overlay of the borders of the flap to be adjusted later. Supplementary elastic support of the looped pedicle by rubber band traction, anchored to collodion-affixed gauze patches, will greatly alleviate weight strain at the suture line.

For comparison of adaptability see Table I and Figures 30 and 31.

Fig. 30. Sloughing arm flaps. Reactions still four-plus after four previous courses of treatment. Nose operation was uneventful after usable flap was secured. (See discussion of case in Figure 10)

a, A diffuse slough in an inner arm flap after making both lateral incisions and complete undermining in one step. The flap was abandoned on account of diffuseness of the slough. In several of our earlier cases, with success attributed to "fool's and beginner's luck," we raised large arm

flaps but a proper delay will likely eliminate the difficulty.¹ No flap should be transplanted the circulation of which had hesitated sufficiently to cause blebs, deep discoloration or diffuse gangrene. Such a flap would most likely not survive both thinning and transfer (Fig 30 a). We would consider worth while the attempt to use a flap that had suffered a sharply outlined distal loss from a frank gangrene provided the flap was still sufficiently

¹ A moderate activity of chronic acne that frequently follows a train trip or other accidental irregularity can usually be quieted and the patient made operable by one exposure to radiation. Proper length and intensity

flaps in two steps, but a good routine is a minimum of three steps.

b, Sharply outlined slough of a flap from the outer surface of the same arm after incising and raising the flap in two steps, but still without dividing the lower pedicle. Because the slough was sharply outlined and limited to a distal fourth, the flap was muzzled along until it had completely healed without any suggestion of change or impaired circulation. c, Spontaneous drawing in and healing of the damaged area, when the flap was successfully used with no hesitation of the circulation. Subsequent observations have forced the conclusion that in this and other losses, the fault was with the plan and not the tissues. This is also emphasized in the case of Figure 31 in which there was no blood dyscrasia.

Fig. 31. Partial raising at two sittings. At the time of application, circulation in the flap appeared adequate but it sloughed following implantation see a, b, Flap was taken down and allowed to heal with good circulation throughout the remnant. Fifteen months later with some secondary lengthening at the base, this flap was again put up, b, with no hesitation. The skin graft repair of the arm, shown in b, was done while awaiting recovery of the sloughed flap. In c, the transverse division of the healed in-place flap was at the level of the mouth slit. Higher than that is not safe as shown by the shortening which occurred after releasing the weight of the pedicle. (For discussion of case see Fig 18)

long or could be lengthened (Fig 30 b). After a second hesitation the flap should not be used. Forced abandonment of a flap at any stage is an embarrassment to the surgeon and more so to the patient. However loss of a transplanted flap is a catastrophe (Fig 31).

Correction of deformities resulting from trauma or disease. The first move in the repair of the donor area is the return and adjustment of the unused pedicle. After this has been transferred and the desired surgical correction made the remaining deficiency at the donor

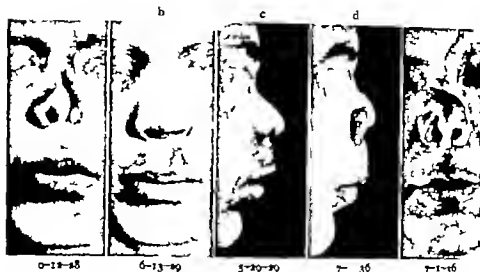


Fig. 32.

Fig. 32. This case emphasizes the need of continual postoperative caution in any congenital or acquired infection.

Nasal and throat ulcerations for 2 years previous to recognition of the cause. Recent treatment of this 20 year old man had brought his blood reaction down from four to two-plus. At our examination he had scarring of the pharynx and palate. Internal nasal destruction and some full thickness loss. Medication was discontinued for a

period before operative correction was undertaken, as is our custom. We used two forehead flaps, one for lining and one for covering (Fig. 8). After these had healed in place, he was sent home for rest and further intensive treatment. Later we inserted cartilage graft into the dorsum, with the result shown in b and c. The length of time treatment was continued after cartilage insertion is uncertain, but he returned 7 years later with the wreckage which is shown in d and e.

site should be eliminated. Granulating or rough scar must be camouflaged or hidden. The borders of small defects might be undermined and approximated, while others must be grafted. It is hardly practical to use a full thickness graft at the time of flap transfer. A split graft might be less conspicuous if drawn tight over a 3 or 4 week old bed of smoothly trimmed granulations as is our common practice on the forehead. On the trunk, residual disfigurements can be hidden by clothing which is also true of a man's arm. In a woman an arm flap should be taken preferably from the inner surface; she can quickly acquire the habit of holding the damaged area close to the chest which makes a smoothly grafted area quite unnoticeable.

It is the exposed donor area of the forehead or arm and repair tissue that does not blend with the surrounding color that chiefly attracts attention. It is very seldom that an infraclavicular graft or flap will have any of the natural facial blush after transfer but it may become more tanned than natural. No matter how perfect the technique, a marked color discrepancy will vitiate an otherwise

quite acceptable result. Most women but few men will use cosmetics or surface stains. The natural red comes from the depths of the skin and surface applications are but easily detected substitutes that lack the true blush coloring. To match free skin grafts and pedicle flaps more nearly with the surrounding skin, pigments can be instilled into the derma of transplanted skin with fine needle points (9).

On the forehead, the original split graft is later discarded for an evenly fitted full thickness graft which is allowed to season before intradermal color is injected. The natural changing face-tinges are live and these cannot be duplicated even by color instillation, but this method is still our best substitute. The tenacity with which the transplant clings to the color characteristics of its source suggests the possibility of some intrinsic local control. For example, grafts and detached transplants taken from below the clavicle will in most instances, eventually lose all vestige of red, while flaps from cheeks or forehead, also postaural grafts, will retain or regain their natural blush shade.

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OBSERVATIONS ON THE TREATMENT OF ADENOCARCINOMA OF THE UTERUS

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IN the past 3 years, 10 women with adenocarcinoma of the uterus, comprising 0.5 per cent of the patients on the gynecologic service have been treated at Walter Reed General Hospital. These cases are presented without 5 year follow up for two reasons: residual carcinoma was found in 6 of the 7 uteri which had received enormous doses of radium by means of the hysterostat designed by one of us (M.F.) and the presence of ovarian metastasis in 3 patients emphasizes the necessity for oophorectomy as part of the treatment.

Recent reports have suggested that pan-hysterectomy with bilateral salpingo-oophorectomy should result in a 5 year arrest of 60 to 65 per cent of operable lesions (4, 11). The impression that the 5 year survival rate may be increased to 70 or 80 per cent by the use of preoperative radium followed by hysterectomy has been growing during the last 10 years. The majority of recent authors have advocated this combined method of treatment. Because small doses of radium in the order of 1,500 to 2,500 milligram hours have relatively little effect on adenocarcinoma of the uterus, conclusions drawn by authors who employed these small doses are of questionable value. The few reported cases treated with 4,000 or more milligram hours of radium are inadequate for a correct statistical evaluation of the combined method of treatment.

Corscaden (1944) reported 25 cases in which patients were treated with radium and hysterectomy in which the 5 year survival rate was 72 per cent. He recommended 3,000 to 4,500 milligram hours if given in one massive dose. Sheffey (1943) reported 30 cases in which patients were treated with

combined therapy in which there was 38.4 per cent survival after 5 years. Only 9 of the 30 patients received doses of 4,000 to 5,000 milligram hours. In his cases of patients treated by surgery alone, the 5 year survival rate was 18.1 per cent.

Ward (1942) reported 37 cases in which combined treatment had been used with 64.9 per cent 5 year survival as compared with 63 per cent in 27 cases in which surgery alone was used. The radium dose varied from 2,400 to 4,000 milligram hours, followed by post-operative x-ray therapy.

Heyman (8) in Sweden (1937) reported 5 year arrest of 78.5 per cent of 65 cases in which treatment consisted of hysterectomy followed by radium and x-ray therapy. In 1941 (9) he reported a series of 402 including inoperable cases in which patients were treated with radiation alone, with a 5 year survival rate of 40 per cent. Included in this group were 156 clinically operable cases in which patients were treated only by radiation and in which the 5 year survival rate was 48.7 per cent. He did not employ the combined treatment of radium followed by hysterectomy except in one subgroup of patients, who were operated on after radium therapy had failed. In this group the survival rate was 46 per cent. The usual radium dose was 3,000 milligram hours delivered in two applications of 1,500 milligram hours at an interval of 3 weeks.

Brindley (1941) reported 24 cases with 79 per cent 5 year survival. He used the combined treatment. The radium dose varied from 800 to 4,800 milligram hours, averaging 2,600 milligram hours.

Miller (1940) reported 34 cases in which treatment consisted of radiation followed by surgery. The 5 year survival rate was 70.5 per cent. Although he recommended pre-

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operative x ray therapy only the exact number of patients so treated and the dose were not mentioned

Morton (1939) reported 18 cases in which the combined treatment produced a 66 per cent 5 year cure. Thirteen additional cases in which surgery alone was used had a 69 per cent 5 year survival rate. The dose of pre-operative radium was not specified

Healy and Brown (1939) reported 28 cases in which 3 000 to 4 000 milligram hours of radium was administered preceding hysterectomy. The 5 year survival rate was 79 per cent

Arneson (1936) treated 10 cases with radium followed by hysterectomy to obtain a 5 year survival rate of 90 per cent. The dose of radium varied from 1 600 to 4 000 milligram hours, 6 patients receiving more than 3 000 milligram hours

These published reports of a relatively small number of cases have been influential in determining the present trend toward combined therapy. The statistics in themselves are not conclusive. The recognized abilities of the authors however demand that their opinions be given careful consideration. Presumably, there are favorable clinical impressions of individual patients salvaged by the combined method which are not entirely reflected in the statistics

In 1934 Sampson warned that a straight radium tandem in the uterine cavity failed to irradiate the uterus homogeneously and that carcinoma localized in the cornu might be unaffected. In spite of his admonition the straight tandem continues to be widely used. Other methods of using radium in the uterus include multiple packing of loose capsules with strings attached or incorporation of capsules in a gauze pack (2). The capsules have been attached to wires (4, 5) in an attempt to fan out the radium. Several other devices have been designed (10, 16, 18)

RADIUM TECHNIQUE

The radium applicator which is called hysterostat was designed to achieve a more equable distribution of radiant energy to all parts of the uterus. Its construction was based on the following features

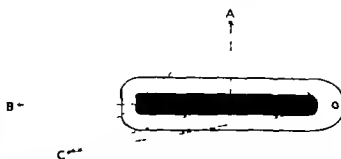


Fig. 1. Diagram illustrating intensity of radium energy distribution around platinum capsule. The greatest intensity is found along the side point A. The weakest intensity of radiation is located at point C which lies obliquely off the end of the capsule. A pencil beam of weak radiation comes directly off the end of capsule to point B (see Fig. 2)

1. Study of the distribution of radiation energy around a radium capsule with a wall thickness (filter) of 1 or 1.5 millimeter of platinum reveals certain data of utmost importance to successful use of radium in the uterus

a. The greatest intensity of radiation is found along the side of a radium capsule (point A, Fig. 1) due to a filtration factor and a distance factor. Most of the rays emanating from all points along the radium source travel obliquely through the metal wall of the capsule to reach point A. The longer path through the wall of the capsule which the oblique rays must traverse subjects them to increased filtration in the metal wall. However this increased filtration is at a minimum for point A as compared with all other points equidistant from the outer wall of the capsule (point C for example). In addition, the average of the distances which the rays traverse from each point along the radium source to reach point A along the side of the radium capsule is shorter than for point C or any other point equidistant from the wall of the capsule

b. The weakest intensity of radiation from a linear radium capsule is located at a point obliquely off the end of the capsule (C, Fig. 1) because the average distance which the rays, from each point along the radium source, travel is longer than for point A. Furthermore many of the rays traveling obliquely through the wall of the capsule to reach point C must traverse eight or more times the stated thickness of the metal wall before emerging from the capsule. Thus the high filtration considerably decreases the intensity of the total radiation reaching point C

c. Radiation coming directly off the end of a linear radium capsule to point B (Fig. 1) is filtered only with the minimum stated filter of 1 or 1.5 millimeters of platinum. This advantage is neutralized by the fact that the average distance which the rays traverse from each part of the radium source is the longest of all the average distances. As a result, a narrow pencil of increased

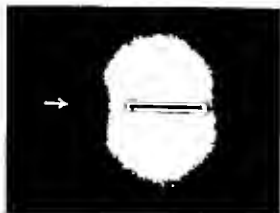


Fig. 2 Actual picture of radiation intensity distribution made by placing a radium capsule against an unexposed film suspended in air. The radium element source is centimeters long and the wall of the capsule is .5 millimeters of platinum. Note the great intensity of radiation along the side of the radium capsule, and the equally striking weakness of the radiation coming off the end of the capsule, with the exception of narrow pencil beam (arrow) in the long axis.

radiation intensity comes off the end of the capsule (see arrow Fig. 2)

d. The great intensity of radiation along the side of the radium capsule, and the equally striking weakness of the radiation coming off the end of the capsule are illustrated in Figure 2. These facts are significant when the tissue to be irradiated comes in direct contact with the radium sources, in the treatment of corpus carcinoma.

2. When several capsules are placed perpendicular to a surface the intensity of radiation reaching that surface will be relatively small. In Figure 3, although 2 capsules are pointed at the cornu, it receives less radiation than those parts of the uterine wall in direct contact with the sides of the capsules.

3. For effective radiation of the fundus of the uterus, one or more radium capsules must lie flat against it. Several tandems or individual capsules pointing at the fundus perpendicularly will not provide comparably effective radiation. The crosspiece of the hysterostat permits proper placement of radium against the fundus (Figs. 4 and 5) and can be adjusted to provide contact with a concave fundus (Fig. 12).

4. Studies of energy distribution around radium sources, according to the Paterson-Parker dosage system for gamma ray therapy¹⁴ indicate that radium sources should be placed peripherally around an area which is



Fig. 3 Self-exposed photograph made with hysterostat containing 6 radium capsules, as in Figure 5b. Hypothetical uterine canal is 7 centimeters long. Although two capsules are pointed at each cornu, the weakness of radiation intensity in the cornu is readily apparent. The fundal myometrium is effectively irradiated by the crosspiece. The midpoint of the triangle is irradiated by crossing from all the capsules, so that additional radium seems unnecessary.

to be homogeneously irradiated, within certain spatial limitations. The addition of multiple sources within the center of this area (packing a uterine cavity with multiple radium capsules) serves to increase the intensity of radiation within the center of a cavity where it is already high (Fig. 3).

5. The hysterostat is constructed of multiple sections which can be screwed together in the operating room after the contour of the uterus has been defined so as to produce a roughly triangular distribution of radium sources within the uterine cavity. Each section is the length of a single radium capsule. Sections in two angulations (150° and 165°) are provided so that a uterine cavity of almost any size or irregular configuration can be fitted (Figs. 5a, b, c). The crosspiece (Figs. 4 and 5) is so arranged that it can occupy four different predetermined angles in relation to

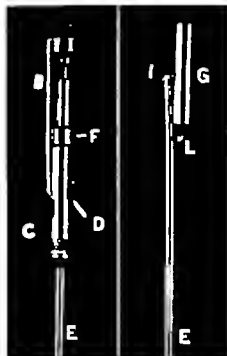


Fig. 4. The crosspiece. The handle end is on the left, the radium end on the right. The flange, *B*, is attached to knob only and slides into the limiting slots, *D*, in the revolving sleeve *C*. The flange must be pulled below the fixed guard, *F*, before the sleeve can be rotated. *E*, Tubular stem through which runs the central wire.

At the radium end of the crosspiece is the shell, *G*, which can be unscrewed and a radium capsule inserted. This can be made any desired length by adding extra straight or angular pieces. The shell is attached by a hinged joint, *I*, to the end of the tubular stem, *E*. The central wire emerging from the tubular stem is attached to one end of the shell by means of an axle joint *L*.

the supporting stem. Four side-pieces are provided but only two of them are needed except in unusually large uteri.

The sheaths which contain the radium capsules are constructed of monel metal tubing with a wall thickness of 0.4 millimeter which provides an ideal secondary filter. These sheaths can be constructed to contain radium capsules of different sizes. We have employed two sizes, 4 by 23 millimeters and 6 by 18 millimeters.

6 The radium dose which we employ has been arrived at by empirical means. Calculation of the distribution of the radium energy to various parts of the uterus in units of gamma roentgens has not yet proved to be of practical value in ascertaining the desired radium exposure of a particular uterus under treatment.

The individual capsules contain 10 or 15 milligrams radium with a primary filter of 1



Fig. 5. Crosspiece and lateral tandems arranged in 3 different hypothetical distributions. a, Arrangement of 4 capsules in a uterine cavity 5 centimeters long. One lateral tandem contains a 150 degree angle section. The other lateral tandem is angulated by bending the flat stem. b, Arrangement of 6 capsules in a uterine cavity 7 centimeters long. This has been accomplished by inserting an extra section into each lateral tandem. c, Arrangement for a large irregular uterine cavity. The additional 2 lateral tandems are available in case a large uterine cavity can accommodate them. Note that each arrangement of the applicators provides one radium capsule in the cervical canal.

or 1.5 millimeters platinum and a secondary filter of 0.4 millimeter of steel. A dose of 1 000 milligram hours per capsule is given when the uterus is normal in size. A small uterus with a cavity 5 centimeters long holding four capsules will receive a total dose of 4 000 milligram hours given in one treatment. If the uterus is larger and contains more radium capsules the individual dose per capsule is from 700 to 1 000 milligram hours. The total doses in this series ranged from 6 000 milligram hours to 12 480 milligram hours.

Generally when the uterus is larger than normal and the total dose is to exceed 5 000 milligram hours radium is given in two treatments at an interval of 7 to 10 days. The



Fig. 6 Case 1: Biopsy before x-ray therapy. This growth is classified as a moderately undifferentiated adenocarcinoma originating in the endocervical glands. The tendency to form lividula structura is clearly shown. $\times 63$.

uterine canal usually shrinks and its shape changes after the first treatment so that the radium must be rearranged for the second treatment.

This technique had been employed in 28 cases by one of us (M.F.) in civilian life prior to 1942. The radium exposures in half of

these ranged from 6,000 to 10,230 milligram hours. These cases will be the subject of a future publication.

Several other devices have been designed for the purpose of obtaining diffuse distribution of radium energy throughout the uterus. Schmitz using a Y shaped applicator administered doses up to 6,000 milligram hours. Kaplan employing a ring applicator administered doses ranging from 6,000 to 7,410 milligram hours.

CASE REPORTS

CASE 1: Moderately undifferentiated adenocarcinoma of the cervix, slightly advanced.

A moderately well nourished white female, aged 39 years, was admitted to the hospital September 4, 1944, complaining of intermenstrual bleeding for 3 months. She had one child aged 17 and had had one miscarriage 2 years ago. Menses were regular every 28 days, lasted 7 days, with moderate flow and no pain. Six weeks before admission the patient noted a mass protruding from the vaginal orifice, which disappeared when she lay down.

On examination, the abdomen was flat and soft, with no masses or tenderness. The vagina was normal. Protruding from the cervix was a hard, rounded mass, 5 centimeters in diameter with a red granular surface which bled easily. The uterus was of the usual size anterior and free. Ovaries were normal. There was no induration in the broad ligaments.

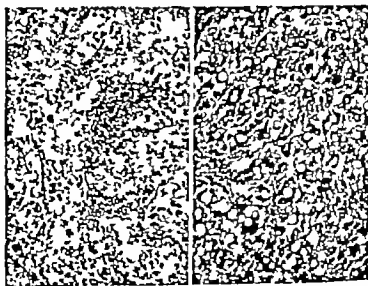


Fig. 7 Left, Case 1: Biopsy 8 days after x-ray treatment started (3 days after completion of tumor dose of 3,030 delivered over period of 5 days). There are slight to moderate radiation effects, predominantly nuclear hyperchromatism and to a less extent cytoplasmic vacuolization. $\times 70$.

Fig. 8. Case 1: Another area of section shown in Figure 7. Here the radiation effects are much more striking. $\times 70$.



Fig. 9. Case 1. Entire uterine cavity showing granulating endocervical surface at site of tumor. The upper portion of the corpus appears relatively normal.

Biopsy of the endocervical tumor showed moderately undifferentiated adenocarcinoma (Fig. 6). Supervoltage x-ray therapy was given with rays activated at 1,000,000 volts over a period of 15 days. The skin dose ranged from 1,000 r to 1,500 r to each of five skin portals. The tissue dose delivered to the tumor in the cervix was 3,030 r.

Three days later (18th day after initiation of treatment) the cervical tumor had shrunk about 20 per cent, and measured 4 centimeters in diameter. The uterine cavity was curetted and the tissue obtained was benign proliferative endometrium. The cervical tumor was excised with endothermy. A radium tandem composed of 3 platinum capsules totalling 60 milligrams of radium was introduced into the uterine cavity and three cork each of 15 milligrams radium were placed in the vagina about the cervix. A total dose of 8,000 milligram hours was given.

Microscopic examination of the cervical tumor (Figs. 7 and 8) revealed in response to 3,030 r extensive destruction of tumor cells. Those remaining showed moderate to marked changes predominantly nuclear alteration and to a lesser degree swelling and vacuolation of the cytoplasm.

Sixty-five days after radium abdominal panhysterectomy and bilateral salpingo-oophorectomy were performed the Richardson technique being used. The peritoneum and intestines were normal. No enlarged lymph nodes or induration were present. The uterus was small and atrophic (Fig. 9) as were



Fig. 10. Case 1. Section of cervix near external orifice showing nests of residual carcinoma deep in the wall. X140.

the tubes and ovaries. There were no adhesions. The postoperative course was entirely uneventful and the patient was discharged on the 18th day.

The excised uterus was examined microscopically and islands of residual carcinoma were seen in the endocervix near the external os (Fig. 10).

Five months after operation the patient was thin and complained of diarrhea and frequency of urination. There was moderate induration at the apex of the vagina with marked redness and yellowish discharge.

This case demonstrates that roentgen therapy can contribute effectively to the destruction of the undifferentiated forms of adenocarcinoma. On the other hand a large radium exposure (8,000 mgm hr.) failed to destroy all the tumor in the cervical myometrium.

CASE 2. Undifferentiated carcinoma of corpus uteri advanced.

This patient aged 61 years white was admitted on August 10, 1911 complaining of irregular vaginal bleeding for 6 months. Eighteen years previously she had received radium for a fibroid tumor of the uterus following which her menses ceased. She had 13 children.

The patient was somewhat obese and her blood pressure was 100/100. The cervix was moderate in size firm and closed. The uterus was of times normal size enlarged more to the left and freely movable. No axial masses or induration were detected.

At time of curettage the uterine canal measured 12.5 centimeters and contained a large amount of yellow friable tissue which proved to be undifferentiated adenocarcinoma on histologic examination (Fig. 11).



Fig. 6. Case . . . Biopsy before x ray therapy. This growth is classified as a moderately undifferentiated adenocarcinoma originating in the endocervical glands. The tendency to form alveolar structures is clearly shown. $\times 63$

uterine canal usually shrinks, and its shape changes after the first treatment so that the radium must be rearranged for the second treatment.

This technique had been employed in 28 cases by one of us (M F) in civilian life prior to 1942. The radium exposures in half of

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Several other devices have been designed for the purpose of obtaining diffuse distribution of radium energy throughout the uterus. Schmitz, using a Y shaped applicator administered doses up to 6,000 milligram hours. Kaplan employing a ring applicator administered doses ranging from 6,000 to 7,910 milligram hours.

CASE REPORTS

CASE 1. Moderately undifferentiated adenocarcinoma of the cervix, slightly advanced.

A moderately well nourished white female aged 39 years was admitted to the hospital September 1, 1944, complaining of intermenstrual bleeding for 3 months. She had one child aged 17 and had had one miscarriage 2 years ago. Menses were regular every 28 days, lasted 7 days with moderate flow and no pain. Six weeks before admission the patient noted a mass protruding from the vaginal orifice, which disappeared when she lay down.

On examination the abdomen was flat and soft, with no masses or tenderness. The vagina was normal. Protruding from the cervix was a hard, rounded mass, 5 centimeters in diameter with a red granular surface which bled easily. The uterus was of the usual size, anterior and free. Ovaries were normal. There was no induration in the broad ligaments.



Fig. 7. Left, Case . . . Biopsy 8 days after x-ray treatment started (3 days after completion of tumor dose of 3,030 delivered over period of 5 days). There are slight to moderate radiation effects, predominantly nuclear hyperchromatism and to a less extent cytoplasmic swelling. $\times 70$.

Fig. 8. Case . . . Another area of section shown in Figure 7. Here the radiation effects are much more striking. $\times 70$.



Fig. 9. Case 1. Entire uterine cavity showing granulating endocervical surface at site of tumor. The upper portion of the corpus appears relatively normal.

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Fig. 10. Case 1. Section of cervix near external os showing nests of residual carcinoma deep in the wall $\times 130$.

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The excised uterus was examined microscopically and islands of residual carcinoma were seen in the endocervix near the external os (Fig. 10).

Five months after operation, the patient was thin and complained of diarrhea and frequency of urination. There was moderate induration at the apex of the vagina with marked redness and yellowish discharge.

This case demonstrates that roentgen therapy can contribute effectively to the destruction of the undifferentiated forms of adenocarcinoma. On the other hand a large radium exposure (8,000 mgm hr.) failed to destroy all the tumor in the cervical myometrium.

CASE 2. Undifferentiated carcinoma of corpus uteri advanced.

This patient aged 6 years white was admitted on August 10, 1941, complaining of irregular vaginal bleeding for 9 months. Fifteen years previously she had received radium for a fibroid tumor of the uterus following which her menses ceased. She had had 3 children.

The patient was somewhat obese and her blood pressure was 100/100. The cervix was moderate in size, firm and closed. The uterus was four times normal size, enlarged more to the left and freely movable. No adnexal masses or induration were detected.

At time of curettage the uterine canal measured 12.5 centimeters and contained a large amount of yellow friable tissue which proved to be undifferentiated adenocarcinoma on histologic examination (Fig. 11).



Fig. 12. Case 2. Section of tumor before therapy showing an extremely undifferentiated carcinoma. The cells are compactly arranged in solid sheets with thin vascular trabeculae coursing throughout. $\times 63$.

The first radium treatment was given on August 18, 1944. By means of a three-piece hysterostat, 12 capsules of 10 milligrams each were inserted in triangular arrangement. The dose was 5,760 milligram hours (Fig. 12).

Fifteen days later another curettage was performed preparatory to the second radium treatment. The uterus had shrunk, the canal now measuring 9 centimeters. A large amount of yellow friable chiefly necrotic tissue was removed apparently from every portion of the corpus. Histologic examination of this tissue revealed considerable necrosis of the tumor cells, but some islands in the



Fig. 13. Case 2. Fragments of tumor 5 days after first radium treatment of 5,760 milligram hours. Moderate swelling and vacuolation of the cytoplasm are noted in areas shown. In other fields moderately differentiated papillary pattern was noted showing milder radiation effects. $\times 63$.



Fig. 14. Case 2. Roentgenograph of hysterostat containing 12 radium capsules. First radium treatment. Uterine canal 12.5 centimeters long, fundus 4.5 centimeters wide, irradiated with angular crosspiece.

undifferentiated portion of the tumor showed moderate swelling and vacuolation of the cytoplasm (Fig. 13). A few areas with a differentiated papillary pattern, not seen in the original biopsy, showed little effect from radiation.

With the three-piece hysterostat in a different, but still triangular arrangement, 12 capsules of 10 milligrams each were inserted in the uterus and a dose of 6,720 milligram hours was administered. The total exposure in the two treatments was 12,480 milligram hours.

Forty-four days after the second radium treatment, panhysterectomy and bilateral salpingo-oophorectomy were performed. The peritoneum and intestines appeared normal. There were no enlarged lymph nodes along the aorta or beneath the pelvic brim. The uterus was smaller than normal and freely movable; both tubes and ovaries were atrophic. In pulling up the uterus, moderate tension being used, the uterine veins were torn on each side and considerable bleeding ensued. The veins were rather small but thin-walled and friable. The parametrial tissues were moderately friable and sutures had a tendency to tear through the tissue. The postoperative course was uneventful and the patient was discharged on the 59th day.

Histologic examination revealed no evidence of residual tumor in the uterus, tubes, or ovaries. The



Fig. 14. Case 2. Uterus removed 44 days after second radium treatment. Total dose of 2 treatments 12,480 milligram hours. Note hemorrhagic and necrotic membrane completely covering the uterine cavity.

uterine cavity was lined with a thick hemorrhagic and necrotic membrane (Figs. 14 and 15).

Two months after operation the patient complained of increasing pain radiating down the back and side of the left leg and there later appeared marked edema of the leg. Six months after operation a firm fixed mass was felt in the lateral left lower abdomen above the inguinal region also edema of the left arm the cause of which had not yet manifested itself.

There are several distinctive features to this case. The first radium dose of 5,760 milligram hours which is ordinarily considered adequate for an undifferentiated tumor was ineffective in that moderate radiation effects were seen in the undifferentiated part of the tumor but only slight effects in the differentiated part. Shrinkage of the uterus brought the peripheral portions of the tumor closer to the radium sources during the second radium administration. The reduction in length of the uterine canal from 12.5 centimeters to 6.5 centimeters is noteworthy.

The total radium dose of 12,480 milligram hours is remarkably large and apparently effectively eradicated the uterine tumor.

CASE 3. Moderately undifferentiated adenocarcinoma corpus uteri, advanced.

This patient white aged 54 years was admitted March 10, 1944, complaining of continuous vaginal

bleeding for 2 months. Menses had been normal and regular until menopause April 1943. She had had 2 children.

The patient was in fair general condition. Bulging from the cervical canal which was dilated to about 4 centimeters was a grayish red granular friable tumor attached to the posterior and right lateral surface of the endocervix and extending well up into the uterus. The corpus was two and one half times normal size in midposition and free



Fig. 15. Case 3. Typical section of uterus shown in Figure 14. Note the organizing hemorrhagic membrane resting directly on the compact, atrophic myometrium. No residual carcinoma found in this case. X47.

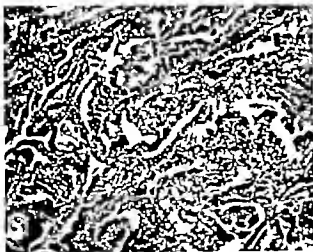


Fig. 6. Case 3. Curettage before therapy showing typical arrangement of moderately undifferentiated adenocarcinoma. While there is a definite alveolar arrangement, in many areas the cells are grouped in compact masses with frequent abnormal mitoses. $\times 63$.

Posteriorly on the right side there was slight thickening. Biopsy revealed moderately undifferentiated adenocarcinoma (Fig. 16).

The presenting tumor was curetted. The canal was 9 centimeters long. A three-piece hysterostat containing 10 capsules of 15 milligrams of radium each was introduced into the uterine cavity (Fig. 17). A dose of 6,450 milligram hours was given.

The second radium treatment 8 days later consisted of the introduction of three corks containing a total of 55 milligrams of radium into the vagina against the cervix. The dose was 3,060 milligram hours. The total radium dose was 9,510 milligram hours.



Fig. 8. Case 3. Curettage 18 days after 6,450 milligram hours intrauterine radium showing one of several nests of residual, moderately undifferentiated carcinoma. There is slight radiation effect. $\times 63$.



Fig. 7. Case 3. Hysterostat containing radium capsules of 15 milligrams each. Uterine canal 9 centimeters long. Dose, 6,450 milligram hours.

Examination at the time of the second radium treatment showed the cervix to be of moderate size and closed. The uterus was twice normal size and free. There was definite thickening in the right uterosacral ligament. The uterine canal measured 9 centimeters. A large amount of yellow necrotic tissue was removed with the curette. Microscopic examination (Fig. 18) revealed islands of carcinoma showing slight radiation changes in the midst of considerable necrotic tissue.

Thirty-nine days after the vaginal radium treatment, panhysterectomy, bilateral salpingo-oophorectomy, and appendectomy were performed. Catheters had been placed in the ureters. The peritoneum and intestines appeared normal. One lymph node 2 centimeters in diameter was densely adherent to the aorta, 4 centimeters above the level of the umbilicus, and was not excised. One lymph node in the right hypogastric area, 1 centimeter in diameter, was excised. The uterus was slightly enlarged and irregular. The tubes were normal. The right ovary was 5 centimeters in diameter, slightly yellowish with a thickened capsule; the left ovary was atrophic. The right uterine vessels were ligated far laterally, laying the ureter to the side and taking the broad ligament tissues on the right. On the left, a conservative approach was made, going straight down along side the cervix. The patient was discharged 36 days after operation.

Histologic examination of the excised tissue revealed small islands of viable-appearing carcinoma.



Fig. 19. Case 3. Section of uterus removed 81 days after intrauterine dose of 6,450 milligram hours and vaginal dose of 3,960 milligram hours radium showing one of the residual neoplastic foci infiltrating the myometrium. The neoplastic cells form tubular structures and show moderate radiation effects. $\times 63$

infiltrating the superficial myometrium in 8 of 10 blocks taken from the corpus (Fig. 19). In the right ovary there was a cystic, metastatic lesion 3 by 3.5 centimeters (Fig. 20). The hypogastric lymph node showed hyperplasia but no carcinoma.

A postoperative course of roentgen therapy (1,000,000 volts) was given to the pelvis. The skin dose was 4,000 r to each of four pelvic portals. This delivered a tissue dose in each broad ligament of 3,160 r over a period of 73 days. Subsequently a second course of roentgen therapy was delivered through four portals crossfiring the preaortic node. The skin dose was $4 \times 3,000$ r; the tumor dose 5,400 r. There was no evidence that this node contained metastatic carcinoma. Eleven months after operation the patient felt well and was quite active.

The intrauterine radium dose was 6,540 milligram hours followed by a vaginal radium dose of 3,960 milligram hours. Nevertheless 81 days after the intrauterine radium treatment, the superficial layers of the myometrium were infiltrated by residual carcinoma which was differentiated in the form of tubular structures.

CASE 4. Moderately undifferentiated adenocarcinoma corpus uteri, early

This patient, aged 50 years white was admitted on July 23, 1944, complaining of moderate vaginal bleeding on one day July 16, 1944. Menopause had occurred 8 years previously. She had had 7 children the youngest then 23 years of age.

The patient was of moderate build. The vagina was thin with some varicosities. The cervix was small and reddened about the closed os. The uterus was small, in midposition and free there was



Fig. 20. Case 3. Metastatic papillary cystic lesion in right ovary lined with large polygonal and columnar cells showing bizarre nuclear changes. The pleomorphism and the nuclear alterations are probably the effects of radiation. $\times 45$

no adnexal mass or induration. The uterine canal measured 6.5 centimeters at the time of curettage. Many small pieces of grayish white tissue were removed.

Microscopic examination showed moderately undifferentiated adenocarcinoma (Fig. 21) generally forming large glandular structures but with occasional scattered compact groups of neoplastic cells and a moderate number of mitotic figures.

One week later radium was introduced into the uterine cavity with a 3 piece hysterostat that contained 6 capsules of 15 milligrams each. A total dose of 6,030 milligram hours was given. This represented a dose of 1,005 milligram hours per capsule.

Forty five days after the radium treatment, pan-hysterectomy and bilateral salpingo-oophorectomy were performed. The peritoneal surfaces and intestines appeared normal. No enlarged lymph nodes were felt along the aorta or under the brim of the pelvis. The uterus was small, the tubes and ovaries atrophic. The tissues of the broad ligaments, cardinal ligaments and vagina were friable and easily torn. The postoperative course was complicated by partial intestinal obstruction and an abscess in the abdominal incision. The patient was discharged 35 days after operation.

The uterine wall averaged from 1.5 to 2 centimeters in thickness and the cavity was lined throughout with a creamy yellowish green necrotic membrane, 1 to 2 millimeters thick. In 4 of 7 blocks residual carcinoma in the superficial myometrium formed large glandular structures with an occasional island of undifferentiated cells showing moderate swelling of the cytoplasm (Fig. 22). In other areas, deep in the myometrium were seen numerous small spaces some partially lined with neoplastic cells of bizarre form.



Fig. 2. Case 4. Biopsy before radium showing moderately undifferentiated adenocarcinoma. In other fields more solid medullary arrangement of the cells was seen similar to that noted along one edge of the photomicrograph. $\times 63$.

Five months after operation the patient felt well and was fairly active. There were no masses or tenderness in the abdomen, and the incision was well healed. The vagina was slightly thickened at the apex. The broad ligaments were soft.

CASE 5. Undifferentiated adenocarcinoma of corpus uteri advanced.

This patient, aged 50 years, white, was admitted on August 31, 1943, complaining of brownish vaginal discharge daily for a year. She continued to menstruate regularly every 28 to 30 days. The flow was moderate, without pain, and lasted 4 days. She had 3 children, the youngest 23 years old.

Examination showed a well-nourished patient. The vagina was normal. The cervix was of moderate size with two minute polyps on the posterior lip. The uterus was twice normal size, irregular in outline anterior and free. The right ovary contained a small cyst 4 centimeters in diameter; the left ovary was atrophic. There was no induration in the pelvis.

Under anesthesia, the polyps were excised. The uterine canal measured 9 centimeters. The cavity was gently curetted. A large amount of friable granular grayish yellow tissue was obtained, apparently from every part of the corpus. Microscopic examination showed the cervical polyps to be benign; the endometrial tissue was for the most part undifferentiated adenocarcinoma (Fig. 23) while in a few fragments, the neoplastic cells were differentiating into glandular structures (Fig. 24).

Intracavity radium was administered in a 13 piece hysterostat, containing 10 capsules of 15 milligrams each (Fig. 25). The uterine cavity was large, the canal being 9 centimeters long, and the fundus 3.5 centimeters wide. For extraneous reasons a dose of 7,000 milligram hours was given, instead of the dose of 10,000 milligram hours which had originally been contemplated.

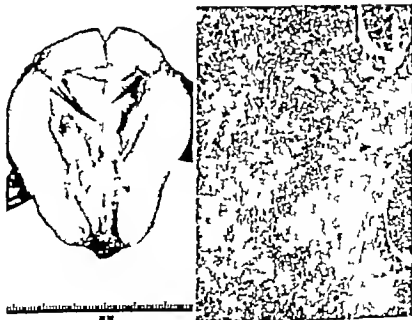


Fig. 22. a, left, Case 4. Uterus removed 45 days after 6,050 milligram hours radium. The diffuse pseudodiphtheritic lining membrane demonstrates the homogeneity of the radiation, and the probable extensive involvement of the entire uterine cavity by the original tumor. b, Residual neoplastic glands in superficial myometrium of corpus. Note the compact undifferentiated masses of neoplastic cells. $\times 70$.



Fig. 23. Case 5. Curettage before therapy showing complete undifferentiation present in parts of the tumor $\times 63$



Fig. 24. Case 5. Section of another fragment showing a definite tendency of the cells to form glandular structures. Compare with Figure 23 $\times 63$

Thirty-eight days after the radium treatment panhysterectomy and bilateral salpingo-oophorectomy were performed. The peritoneum and intestines were normal. No enlarged aortic or hypogastric lymph nodes were palpable. The uterus was slightly enlarged and free. The tubes and ovaries were atrophic. The cardinal ligaments and vaginal tissues were slightly edematous and felt fragile but no technical difficulty was encountered. The postoperative course was uneventful, and the patient was discharged after 23 days.

The cavity of the uterus was somewhat expanded with the canal measuring 7.5 centimeters (Fig. 26). Extending upward from the internal os was a pseudodiphtheritic membrane 3 by 4 centimeters in diameter and 3 to 4 millimeters thick. The upper posterior wall of the corpus was covered with a hemorrhagic membrane. Sections taken through the lower portions of the corpus revealed extensive carcinoma deep in the myometrium the surface being covered with the thick pseudodiphtheritic membrane. Similar carcinoma infiltrating the myometrium was found in sections from each cornu, occurring for the most part as infiltrating sheets of cells, with little tendency to form alveolar structures. The effects of irradiation were mild to moderate, and included slight swelling of the cytoplasm and the presence of a moderate number of bizarre nuclear forms (Fig. 27).

Seventeen months after operation, the patient felt better than she had in years, and had gained 15 pounds. The abdomen was soft. The vagina was thin and pale, somewhat shortened, well healed and with no residual thickening. The broad and uterosacral ligaments showed no induration.

This is a case of predominantly undifferentiated carcinoma similar to that in Case 2 in which a radium exposure of 7 000 milligram

hours failed to destroy the carcinoma completely.

CASE 6 Moderately differentiated carcinoma of corpus uteri moderately advanced

This patient aged 35 years white was admitted on December 31, 1944 complaining of vaginal bleeding which had continued for 18 months. Menarche occurred at 14 with intermittent menses until she was 16 when they ceased completely. In August, 1943 when the patient was 33 vaginal spotting began. After February 1944 bleeding became almost constant. She had had dyspnea on exertion since youth.



Fig. 25. Case 5. Hysterostat containing 10 radium capsules of 15 milligrams each. Uterine canal measured 9 centimeters long; fundus measured 3.5 centimeters wide. Crosspiece contained two capsules.

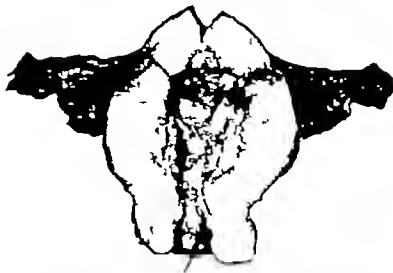


Fig. 26. Case 5. Uterus removed 38 days after 7,000 milligram hours of radium. Note the thick necrotic membrane covering the endometrial surface except for a triangular area on the posterior wall not covered by the hysterostat.

The patient was slender. Mitral stenosis with cardiac insufficiency was evident. The cervix was rather small, the os slightly dilated with a minute polyp high in the canal. The uterus was anterior slightly enlarged, symmetrical, and freely movable. Both ovaries were normal in size and were free.

At time of curettage the uterine canal measured 8 centimeters. A large amount of friable, yellowish tissue was obtained apparently from every portion of the interior of the uterus. Intracavity radium was administered with a 3 piece hysterostat con-

taining 7 capsules of 10 milligrams of radium each. A total dose of 7,000 milligram hours was given. Microscopic examination of the endometrium revealed moderately differentiated, infiltrating adenocarcinoma (Fig. 28).

Fifty five days after treatment, panhysterectomy and bilateral salpingo-oophorectomy were performed. The peritoneum and intestines appeared normal. There were no enlarged aortic or hypogastric lymph nodes. The uterus as small as moderately atrophic, both tubes and ovaries were atrophic. There was no technical difficulty at operation. The excised uterus (Fig. 29) was small and firm with a narrow tubular canal, approximately 1 centimeter in diameter and 6 centimeters long. The walls of the cavity were lined with firm red granulations. There was no pseudodiplothermic membrane. Microscopic examination showed, in 3 of 6 blocks, neoplastic glands infiltrating the endometrium. The effect of irradiation on the cells lining the alveoli was insignificant (Fig. 30).

The postoperative course was complicated by prolonged diarrhea and painful frequent micturition. After 2 months, the tissues at the apex of the vagina separated and formed an ulcer 3 centimeters in diameter. There was induration around the ulcer particularly beneath the bladder.

The uterine cavity was not large, the radium distribution and dose (7,000 milligram hours) was adequate according to our own concept of dosage but there was residual carcinoma infiltrating the myometrium.

CASE 7. Moderately differentiated adenocarcinoma of corpus uteri, advanced.



Fig. 27. Case 5. One of the several foci of residual carcinoma in the uterus shown in Figure 26. Extensive deep infiltration was found, generally by sheets of cells showing little tendency to form alveolar structures. Note the slight swelling of the cytoplasm and many bizarre nuclear forms. $\times 45$.

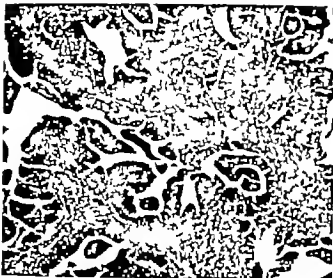


Fig. 28. Case 6. Fragments removed at time of diagnostic curettage composed of moderately differentiated neoplastic glands infiltrating the myometrium. $\times 63$.

This patient aged 67 years white was admitted on August 15 1944 complaining of pink mucoid discharge for 18 months. The patient had four children, the youngest 22 years old. The menopause had occurred 20 years ago. One year ago 6 x ray treatments given elsewhere stopped the pinkish discharge for 4 months.

The patient was obese and had hypertension (220/110) and arteriosclerosis. There were no abdominal masses or tenderness. The mucous membrane of the atrophic vagina was red; the cervix was small, firm and red. The uterus was in midposition and two one half times normal size. No adnexal mass or induration was felt.

At time of curettage the uterine canal measured 8 centimeters. Microscopic examination of the tissue obtained revealed moderately differentiated infiltrating adenocarcinoma (Fig. 31).

One week later a 3 piece hysterostat was inserted containing 9 capsules of 10 milligrams radium each. The dose given at this first radium treatment was 4,500 milligram hours. Eight days later the patient developed pelvic cellulitis, and at this time there was moderate induration in the rectovaginal septum and marked induration in the left broad ligament. The temperature and discomfort gradually subsided and the patient was discharged. Persistent pelvic induration caused the second radium treatment to be deferred.

Seventy days after the first radium treatment the patient returned with no complaints and no bleeding. Penicillin was given prophylactically for 5 days. Under anesthesia the uterus was one and one-half times normal size and fairly movable. There were no palpable adnexal masses but there was some thickening in the left uterosacral ligament. The uterus was thoroughly curetted. The endometrium was scant and the interior of the uterus was quite rough to the curette. At this time the uterine



Fig. 30. Case 6. Uterus and adnexa 55 days after 7,000 milligram hours of radium. Note the small uterine cavity covered with a granulating membrane.

canal measured 6.5 centimeters. A 3 piece hysterostat containing 8 capsules of 10 milligrams radium each was inserted and a dose of 4,400 milligram hours given (Fig. 32). The postoperative course was uneventful.

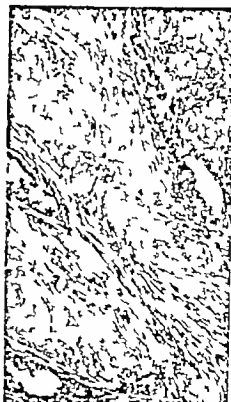


Fig. 30. Case 6. Low power showing one of the several residual areas of carcinoma infiltrating the myometrium. $\times 56$.



Fig. 3. Case 7. Biopsy before therapy showing moderately differentiated adenocarcinoma infiltrating the myometrium. X63.

Curettage 75 days after the first treatment of 4,500 milligram hours dislodged only a few fragments of tissue; however, they consisted mostly of persistent adenocarcinoma infiltrating the myometrium and showing no demonstrable effects of irradiation.

Eight months after the first radium treatment the patient felt well except for occasional bearing down sensations in the lower abdomen. The uterus was smaller than normal; pelvic induration had diminished. Panhysterectomy and bilateral salpingo-oophorectomy were performed. The operative



Fig. 33. Case 7. Uterus 6 months after second radium treatment. Uterine canal now measures 4.5 centimeters long (original length 8 centimeters). Not the uterine cavity completely lined with shaggy necrotic membrane.



Fig. 32. Case 7. Second radium treatment. Uterine canal has shrunk to 6.5 centimeters in length and 4.5 to 7 centimeters in width. Hysterostat now carries 8 capsules of 50 milligrams each. Dose 4,160 milligram hours. Total dose, 9 treatments, 8,900 milligram hours.

procedure was complicated by numerous post-inflammatory adhesions. There was marked chronic salpingitis, with moderate induration of the ovaries, sacral and left cardinal ligaments fixing the uterus deep in the pelvis.

The uterus was small with a canal 4.5 centimeters long. The cavity was completely lined with



Fig. 34. Case 7. Section of uterus shown in Figure 33 with residual carcinoma deep in the myometrium. X1.



Fig. 35 Case 8. Fragments from diagnostic curettage made up entirely of solid masses of large polygonal neoplastic cells similar to the arrangement seen in Cases 2 and 5. In other areas the cells are differentiating into large glandular structures. Mitoses are numerous throughout with many abnormal forms. This is classified as a moderately undifferentiated adenocarcinoma. $\times 63$



Fig. 36 Case 8. Section of uterus removed without usual preoperative course of radium showing residual zone of carcinoma in only one of the multiple sections taken $\times 63$

shaggy membrane beneath which patchy areas of organization were seen. The myometrium was not significantly thinned and the vessels were prominent (Fig. 33). Microscopic examination of 14 serial, cross-section planes through the entire uterus revealed tumor in 2 sections of the midcorpus. The tumor was present as elongated glandular structures deep in the myometrium in one (Fig. 34) while in the other the neoplastic cells were arranged in a solid nest.

The patient received a total dose of 8,900 milligram hours intrauterine radium in 2 treatments which brought about shrinkage of the uterus and disappearance of the symptoms. The outlook for arrest without hysterectomy seemed hopeful. However the finding of residual tumor in the other cases had demonstrated the necessity of hysterectomy wherever possible. Therefore operation was performed in spite of hypertension, obesity, diabetes, advanced age, and residuals of pelvic inflammation.

Residual carcinoma was present 75 days after the first radium treatment of 4,500 milligram hours, a dose which is considered adequate by many operators. Five and one-half months after the second radium treatment of 4,400 milligram hours several small islands of residual cancer could still be found deep in the myometrium. They might have remained dormant during the rest of the pa-

tient's life span but their removal increased the possibilities of a cure.

CASE 8. Moderately undifferentiated adenocarcinoma early almost completely removed at original biopsy curettage surgical treatment only.

This patient, aged 39 years, white, was admitted to the hospital December 4, 1944. Menses had customarily lasted 4 days with moderate flow. However she had a prolonged menstrual period lasting 8 days in August and again in November and December, 1944. There was no intermenstrual bleeding.

The vagina appeared normal, the cervix was smooth, firm and closed. The corpus was small and free, the ovaries normal.

The uterus was curetted thoroughly and a moderate amount of soft grayish tissue was obtained. Microscopic examination revealed moderately undifferentiated adenocarcinoma (Fig. 35). Panhysterectomy and bilateral salpingo-oophorectomy were performed. There was no evidence of extension or metastasis. The uterus tubes and ovaries appeared normal.

The interior of the uterus seemed normal when inspected grossly but on microscopic examination one minute neoplastic focus was found, others apparently having been curetted away (Fig. 36).

The postoperative course was uneventful 3 months later the patient was well and showed no evidence of disease.

This is an early case of moderately undifferentiated adenocarcinoma of the uterus treated only by extirpation of the uterus tubes and ovaries. The curettage for biopsy almost completely removed the tumor.

TABLE I—SUMMARY OF CASES

Case No.	Duration Age symptoms	Type adenocarcinoma	Preoperative radiation	Interval radium to posthysterectomy	Pathology after operation	Follow up after last treatment
34	1 mo	Moderately undifferentiated (adenocarcinoma)	X-ray tumor dose 3050 14000 mgm. hr in uterus and vagina	66 days	Islands carcinoma endometrium	3 mo No recurrence
67	1 mo	Undifferentiated	2,480 mgm. hr	44 days	No carcinoma	10 mo Local per vaginal recurrence
54	1 mo	Moderately undifferentiated	0.4 mgm. h (4390 mgm. hr in uterine cavity 3050 mgm. h in vagina)	30 days	Islands carcinoma uterus and right ovary	14 mo No recurrence
20	1 mo	Moderately undifferentiated	6050 mgm. hr	43 days	Islands carcinoma uterus	20 mo No recurrence
20	1 mo	Undifferentiated	7000 mgm. hr	38 days	Islands carcinoma uterus	21 mo No recurrence
5	8 mo	Moderately differentiated	7000 mgm. hr	33 days	Islands carcinoma uterus	1 mo No recurrence
67	8 mo	Moderately differentiated	4000 mgm. hr	4 months	Islands carcinoma uterus	6 mo No recurrence
20	1 mo	Moderately undifferentiated	None	—	Superficial island carcinoma	4 mo No recurrence
58	Several yrs	Moderately differentiated	None	—	Advanced carcinoma uterus with metastases both ovaries	Died 4 mo metastases
45	0 mo	Moderately differentiated	None	—	Adenocarcinoma uterus with ovarian metastases	10 mo No recurrence

CASE 9. Moderately differentiated adenocarcinoma corpus uteri, advanced with metastasis to ovaries

This patient, aged 58 years, white was admitted on August 11, 1942 with a history of daily bloody spotting from the vagina for many years. Menses ceased at 40 years.

The patient weighed 200 pounds. Abdominal palpation revealed large masses rising from the pelvis to the level of the umbilicus. The cervix was high in the vagina, smooth and closed. The fundus could not be distinguished from the lower abdominal masses. There was no induration or fixation of the pelvic floor.

At operation the uterus was two and one half times normal size soft and nodular. Both ovaries formed large cystic lobulated tumors, 35 centimeters and 0 centimeters in diameter. The ovarian tumors fallopian tubes and supracervical portion of the uterus were excised with difficulty.

Microscopic examination revealed extensive infiltrating moderately differentiated adenocarcinoma of the uterus with bilateral ovarian metastases.

Sixteen days later radium was inserted into the cervix and vagina for a total dose of 3,600 milligram hours. An incomplete course of postoperative roentgen therapy was given elsewhere. Six months later the patient died with peritoneal carcinomatosis ascites and a large metastatic retroperitoneal tumor.

This patient is recorded as an instance of ovarian metastasis, the significance of which will be discussed later.

CASE 10. Adenocarcinoma corpus uteri, bilateral ovarian metastasis.

This patient, aged 45 years, white, had constant vaginal bleeding from July 1944 until January 1945, when a total hysterectomy was performed at another hospital, for adenocarcinoma of the uterus. On admission to this hospital in March 29, 1945, no pelvic masses were palpable. Because of the frequency of ovarian metastasis, the abdomen was reopened. Although no obvious metastasis was observed both tubes and ovaries were removed. Gross examination of the cut surface of the right ovary and microscopic examination revealed secondary adenocarcinoma.

This case demonstrates the necessity for oophorectomy as part of the routine treatment of adenocarcinoma of the uterus. The use of radium alone is attended by the danger of neglect of ovarian metastasis.

ANALYSIS OF CASES

In this series of 10 cases of adenocarcinoma of the uterus, 9 were moderately advanced or advanced but without induration of the pelvic ligaments, and were therefore considered operable. Carcinoma protruded from the cervical os in two uteri and ovarian metastasis was subsequently found in 3 patients. Microscopic examination revealed moderate differentiation (grade 2) in 4 cases, moderate im-

differentiation (grade 3) in 4 cases, and complete undifferentiation in 2 cases. This distribution is atypical in that most large series have shown the majority of cases to be differentiated adenocarcinoma.

In 7 of the 10 cases treatment with radium was followed by panhysterectomy and bilateral salpingo-oophorectomy. The radium dose ranged from 6,030 to 12,480 milligram hours. Case 1 (the only instance of adenocarcinoma of the endocervix) had an x ray tumor dose of 3,030 r followed by 8,000 milligram hours of radium.

The size of the uterus was moderately or greatly reduced following radium. In Case 7 for example the uterine canal shrank in length from 8 to 4.5 centimeters. In Case 2 the uterine canal shrank from 12.5 centimeters to 6.5 centimeters.

The operative procedure was not unduly difficult except in Case 7 in which the residuals of pelvic inflammation complicated the operation. In every instance the parametrial tissues were somewhat sclerotic, with lack of resiliency and the sutures had to be tied with care. The uterine vessels seemed smaller than usual. In one instance the uterine veins were torn on each side as the uterus was being elevated. The Richardson conservative panhysterectomy technique was used in all except Case 3 in which a radical dissection was performed on the right side only because of slight preradiation thickening in the right uterosacral ligament.

Interesting was the finding of nests of apparently viable cancer cells in the superficial myometrium in 6 of the 7 excised uteri, with deeper extension in 3. The one uterus (Case 2) in which no residual carcinoma was found had a highly malignant undifferentiated adenocarcinoma which received 12,480 milligram hours of radium given in 2 exposures.

The location of residual carcinoma deep in the myometrium explains why probatory curettage performed several months after radium treatment in order to evaluate its effectiveness, may fail to extract the residual carcinoma.

It is possible that, after irradiation some of this residual carcinoma might not have manifested itself clinically for 5 years or longer.

However hysterectomy is necessary to complete eradication of the local tumor.

Reasons why the combined radium surgical treatment gives the best results according to the literature include (1) reduction of intra uterine infection preoperatively (2) reduction in size of the uterus simplifying the operative procedure (3) immobilization of cancer cells in the uterus reducing metastasis (4) sclerosing of lymphatics and blood vessels reducing metastasis (5) prevention of recurrence from operative spill in the vagina and abdominal incision and (6) favorable results borne out of statistical evidence.

Statistical evidence however is the only concrete information on the value of preoperative radiation. The available statistics discussed previously are based on small series varying from 10 to 37 cases. The 5 year arrests range from Sheffield's 38.4 per cent in 30 cases to Arneson's 90 per cent in 10 cases. Series of as many as 100 cases with uniform radium treatment in doses of 4,000 milligram hours or more should be available before the rôle of preoperative irradiation can be evaluated.

Preoperative roentgen therapy has been recommended by some notably Miller who emphasizes the additional destruction of tumor cells in the parametrium by this method. However the intensive x ray therapy necessary to give a lethal tumor dose may cause destructive changes in the bowel, and adhesions. The immediate postradium complications following the use of large doses were not serious. The one instance of acute pelvic cellulitis (Case 7) followed a relatively small radium dose of 4,500 milligram hours. However the later deleterious effects of intra uterine radium in the large doses employed in this series are not to be overlooked. Post operative hospitalization is lengthened. Recovery of vitality is often delayed for months. There may be delayed healing of the vaginal wound intermittent diarrhea, and frequency of urination. If the eventual cure rate is increased these disadvantages can be disregarded.

One patient (Case 8) had undifferentiated adenocarcinoma for which many authors recommend preoperative radium. The short

history scant endometrium and small uterus indicated an early lesion. Hysterectomy was performed without preliminary radium. Three patients (Cases 3, 9 and 10) had metastasis in the ovary. This not uncommon incidence of ovarian metastasis is frequently overlooked in planning therapeutic procedures for adenocarcinoma of the uterus. It constitutes an important argument against the use of radium alone in the treatment of this disease. Preoperative radium cannot materially affect the metastatic lesion in the ovary. Consequent postradium hysterectomy should not be unduly delayed.

SUMMARY

Ten patients with adenocarcinoma of the uterus were treated in the past 3 years at Walter Reed General Hospital. Seven patients received unusually large doses of radium (6,030 7,000 7,000 8,000 8,900 10,410 12,480 milligram hours) followed by hysterectomy 38 days to 6 months later. Six of these 7 uteri showed residual carcinoma. The one case in which there was no remaining carcinoma after radium was an extensive undifferentiated tumor in a large uterus treated with 12,480 milligram hours radium. One patient with very early undifferentiated adenocarcinoma was treated with surgery alone. Three patients had ovarian metastasis.

CONCLUSION

1. This study suggests that radium alone will not completely eradicate adenocarcinoma of the uterus. Subsequent excision of uterus, tubes, and ovaries is necessary.

2. The exact rôle and specific indications for preoperative radium therapy have not yet been satisfactorily delineated.

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PRACTICAL OBSERVATIONS ON THE COPPER SULFATE METHOD FOR DETERMINING THE SPECIFIC GRAVITIES OF WHOLE BLOOD AND SERUM

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THE clinical significance of the measurement of the specific gravities of whole blood and plasma or serum has been discussed by Barbour and Hamilton Weech *et al* Scudder Kagan Ashworth and Adams (1) Gray and Elliot Phillips *et al* Technical complications have at times offered impediments to the routine clinical application of several methods particularly in a military sense The authors of the copper sulfate technique (Phillips Van Slyke Dale Emerson Hamilton and Archibald) point out that this is a technically simple quickly conducted procedure which maintains a sufficient degree of accuracy under the usual variable circumstances to give it much clinical applicability In the present communication it is proposed to present additional evidence in support of the practical use of the copper sulfate values of whole blood and serum specific gravities

METHODS

The copper sulfate solutions were prepared as outlined by Phillips and co-workers. The stock solutions (specific gravity 1.1) were checked periodically by pycnometric procedures At times when solutions were prepared aboard ship pycnometry was not possible and the fresh standard solutions were checked via a series of normal samples with previously pycnometrically checked solutions. It was possible at other times to compare our solutions with those prepared by Army laboratory facilities ashore The constancy of checks established much confidence in the technique.

This work was commenced at the suggestion of and progressed under the direction of the senior author, Fleet Medical Officer Sea Commander Allied Naval Forces, Southwest Pacific Area.

Altogether 16 different batches of the stock solution were used in preparing the various standard sets used in the observations

For the actual determination the following procedure was used throughout venous blood was collected in a dry syringe (5 to 20 cc capacity) while stasis was limited as much as possible and drops from the syringe tip before clotting occurred were used for measuring the blood specific gravity the remainder of the blood was allowed to clot in a test tube spun in a centrifuge and the specific gravity of the serum was determined with the aid of a medicine dropper

The Sahli hemoglobin measurements were conducted first with daylight then with artificial light as background for color matching 14.5 grams per cent were considered as 100 per cent normal The red blood cell counts were done with routine type of equipment 10 squares being counted on each occasion

NORMAL VALUES

The normal series were taken from inactive normal healthy Army and Navy personnel (males) most of whom had been established in staging areas at sea level in tropical localities for weeks to months The samples were taken throughout the day prior to which time the individuals had been ambulatory for varying intervals

The frequency distribution of the whole blood specific gravity values on 577 different individuals is given in Table I The following features of these data are emphasized The over all range is 1.052 to 1.064 with only one value falling in each of these extremes the arithmetic mean value 1.0581 the standard deviation (σ) is 0.0019 the mean $\pm 2\sigma$ equals 1.0543 to 1.0619

The frequency distribution for the serum values on 574 of the above 577 samples is also given in Table I. The range for these values is 1.024 to 1.030 with only one value occurring below 1.025; the mean is 1.0273, the σ equals 0.0013; the mean $\pm 2\sigma$ equals 1.0247 to 1.0299.

These normal values have been taken as the basis for evaluating values obtained from subjects under various abnormal states in tropical zones (New Guinea to the Philippine Islands). It has been considered safe to state that blood specific gravity values by this technique outside of the range of 1.0543 to 1.0619 (mean $\pm 2\sigma$) are significant in denoting red blood cell dilution or concentration beyond normal limits. By the same token serum specific gravity readings outside of the range 1.0247 to 1.0299 have been considered significant in denoting dilution or concentration of the serum proteins beyond normal limits.¹

SPECIFIC GRAVITY VALUES RED CELL COUNT HEMOGLOBIN CONCENTRATION (SAHLI) COMPARISON ON NORMALS

It will be noted in Table II that the Sahli hemoglobin concentration as read against artificial light averaged about 0.8 per cent higher figures than the comparisons read against daylight.

All three of these values (specific gravity of blood hemoglobin concentration red blood cell count) depend mainly on the concentration of red cells per unit of blood for their level and so long as the methods of determination are reasonably correct one expects a satisfactory correlation between the values. The correlation obtained by the routine measures as demonstrated in Table II seems satisfactory, close and resembles similar correlations presented by Ashworth and Adams (1) and by Gray and Elliot utilizing other specific gravity and hemoglobin methods.

¹Significance is being given these ranges, means and deviations mainly because significance has been given to findings from similar and related procedures on such inactive normals. He had been ambulatory were compared with patients. He was of accuracy of stretcher type. Yet should be mentioned the physiologists point out that the plasma volume is somewhat lower in the erect posture than during recumbency due to the escape of type of fluid from the circulation which tends to concentrate both the red cells and the serum proteins (4). The study of Ferrer and Berlier demonstrating lowering of the serum protein concentration during the recumbency of sleep can be taken as additional elaboration of this concept.

TABLE I.—FREQUENCY DISTRIBUTION OF WHOLE BLOOD AND SERUM SPECIFIC GRAVITIES ON NORMALS.

Blood		Serum	
Sp. gr.	Frequency	Sp. gr.	Frequency
1.051	0	1.021	0
1.052		1.024	1
1.053	3	1.025	10
1.054	13	1.0255	10
1.055	35	1.026	4
1.056	60	1.0265	11
1.057	94	1.027	12
1.058	122	1.0273	51
1.059	68	1.028	20
1.060	86	1.0285	10
1.061	13	1.029	10
1.062	15	1.030	10
1.063	3	1.03	
1.064			
1.065	0		
Total	577	Total	574

The whole blood values are entirely symmetrical. The lower boundary of the "half" values in serum series is considered due to the presence of which encompasses whole values 1 or less, the tendency toward the whole values where the drop of serum acts as having no gravity between the half and the whole values.

VARIATIONS IN SPECIFIC GRAVITY VALUES IN NORMAL SUBJECTS INDUCED BY VARIOUS SOLUTIONS ADMINISTERED INTRAVENOUSLY

The variations in the specific gravities of whole blood and serum samples from normal subjects over a 24 hour period effected by substantial volumes of physiologic saline solution, normal human plasma, concentrated human plasma (four fold concentration) and concentrated human albumin (25 grams per cent) given intravenously were observed. The results are presented in Figure 1 which also contains similar observations following a comparable volume of whole blood given a subject with slight hemodilution.

Considering that the specific gravity of whole blood is due mainly to the concentration of red cells and that the serum specific gravity is due mainly to the concentration of the proteins, certain observations are evident. Saline, normal plasma, concentrated plasma and concentrated albumin all gave rise to dilution of the recipient's red cells. Following the latter three solutions this dilution remained evident until 12 to 24 hours had passed when preinfusion levels were reached. For saline the dilution was evanescent and a preinfusion level was noted 90 minutes after the infusion. The protein-containing solutions (normal plasma, concentrated plasma, concentrated

TABLE II.—COMPARISON OF SPECIFIC GRAVITY VALUES, HEMOGLOBIN CONCENTRATION BASED ON THESE VALUES AND TAKEN FROM THE PHILLIPS AND ASSOCIATES CHART THE HEMOGLOBIN CONCENTRATION BY SAHLI'S TECHNIQUE DAYLIGHT AND ARTIFICIAL LIGHT READINGS AND THE RED BLOOD CELL COUNT

No	Blood Sp. gr.	Serum Sp. gr.	Hgb. chart grams per cent	Daylight Sahli gms. per cent	Daylight Sahli per cent N	Art. light Sahli gms. per cent	Art. light Sahli per cent N	Rbc. mill.	No	Blood Sp. gr.	Serum Sp. gr.	Hgb. chart grams per cent	Daylight Sahli gms. per cent	Daylight Sahli per cent N	Art. light Sahli gms. per cent	Art. light Sahli per cent N	Rbc. mill.
1	1.037	1.033	5	16		7.0	117.3	4.778	21	1.036	1.035	14.7	5.0	114	5.5	106.8	4.6
	1.033	1.035	14.0	5.3	104.8	16	0	4.64	22	1.0378	1.0361	5.0	6.0		16.3	115.8	4.0
3	1.033	1.036	13.0	14.6	100.6	5.6	107.5	4.47	3	1.035	1.036	5.0	5	103.4	5.5	106.8	4.50
4	1.0345	1.0375	13.3	14.4	99	15.5	106.8	4.435	24	1.036	1.0365	16.	10.5	118	17.0	117.7	5.67
5	1.036	1.036	15.4	5.5	106.8	6	1.7	5.1	25	1.0365	1.037	6.0	7	117.3	7.5	100.6	5.54
6	1.036	1.035	4.3	6.0	11	16.5	118	4.34	26	1.036	1.036	5.8	6.5	4.8	7	126.5	4.86
7	1.0345	1.0365	13.4	5.9	106.8	6.1		4.31	7	1.036	1.035	14.8	6		16.5	12.8	4.8
8	1.035	1.033	14.8	5.5	106.8	16	10	4.63	28	1.036	1.036	14.3	14.5	100	5.0	103.4	4.83
9	1.035	1.0365	13.8	14.5	100	15.5	106.8	4.365	29	1.038	1.037	5.	7.0	117.3	7.5	100.6	5.37
10	1.037	1.035	13.3	5	103.4	6.0		4.7	30	1.035	1.036	13.0	15.0	5.4	5.5	106.8	4.7
11	1.035	1.035	14.4	5.3	106.8	15.5	106.8	4.74	31	1.0378	1.036	5.5	10.5	5.8	7	7.7	4.66
	1.036	1.037	5.7	6	1	16.5	118	5.07	32	1.037	1.0345	5.5	10		10.5	5.8	5.3
12	1.037	1.037	14.7	5.0	103.4	5.0	106.8	5.18	33	1.0375	1.036	5.	5.5	106.8	6	11	4.85
14	1.035	1.036	13.0	5	103.4	5.3	105.5	4.335	34	1.035	1.036	5.0	5.0	103.4	15.5	106.8	4.00
5	1.0345	1.035	3.9	5.8	106.8	16.5	117.7	4.365	35	1.035	1.037	14.3	5	114	5.5	106.8	5.14
16	1.036	1.036	16.8	6.5	118.8	7.5	100.6	5.16	36	1.036	1.037	5.6	5	114	5.5	106.8	5.38
17	1.038	1.037	12.3	5.5	106.8	6		4.71	37	1.0365	1.036	14.6	5.6	107.5	6		4.7
18	1.036	1.0365	13.5	17.0	17.5	17.5	106.8	5.17	38	1.0355	1.036	14.	5.0	5.4	11.5	106.8	4.38
19	1.036	1.0355	4.5	14.5	100	5.5	106.8	5.	39	1.035	1.036	7.7	8.5	117.5	10	12	5.64
20	1.038	1.035	5.7	6.5	8	17.3	8.6	5.05	40	1.038	1.037	5.	5.0	103.4	5.5	106.8	5.5
									41	1.037	1.036	12.87	5.13	104.8	6.7		4.840

Abbreviations: Sp. gr. specific gravity; Hgb. chart, hemoglobin concentration as obtained from the Phillips chart per cent normal; hemo normal is taken as 14.5 grams per cent; Rbc. mill. red cell count expressed in millions, average.

bumin) produced little change in the serum protein concentration. Conversely saline effected a marked drop in the protein concentration which returned to preinfusion levels only after some 6 hours had elapsed. Blood given to a subject with specific gravity values slightly below normal caused an elevation in the red cell concentration the continuation of which must have become augmented by red cell production and liberation from active bone marrow areas. Little change occurred in the serum protein concentration from this infused volume of blood.

ISOLATED CASES ILLUSTRATING THE CLINICAL APPLICATION OF COPPER SULFATE SPECIFIC GRAVITY VALUES

The isolated cases used in demonstrating the clinical application of the specific gravity

values were all battle casualties occurring in various engagements during the recent Philippine campaign. At present the emphasis is placed mainly on the specific gravity studies as they deviate from the normal. A correlation of such studies with other aspects of casualty care, as types and volume of intravenous solutions used, types of cases, response to therapy—with main consideration of the shock state—will be presented later in a compilation of over 300 closely observed cases out of some 5,000 casualties handled by our medical facility (16).

HEMORRHAGE

It has long been emphasized that the loss of whole blood from the circulation is followed by dilution of the remaining red cells. Whether there is dilution of the serum (or plasma) pro-

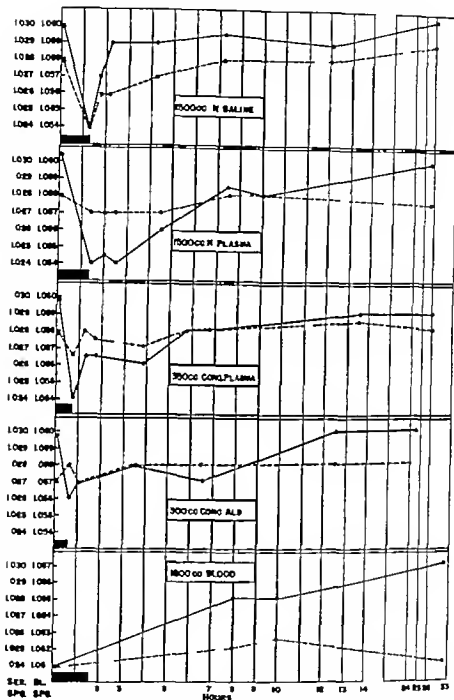


Fig. 1. A demonstration of the changes in the specific gravities of whole blood and serum induced on normal subjects by various commonly used intravenous fluids. Comparable volumes were used. The normal plasma, concentrated plasma, concentrated albumin solution each contained approximately 75 grams of proteins. The blood was diluted about 1 to 5 with citrate-dextrose anticoagulant preservative solution. The time interval for the infusion is designated at the lower left corner. The solid lines represent whole blood specific gravities, the broken lines serum specific gravities.

teins over a sustained period seems to depend on several factors as the extent of blood loss, the interval of time before a determination is

made, the state of the protein stores, the demands on the protein stores by other complications, etc. The hemodilution commences

TABLE III.—SPECIFIC GRAVITY VALUES IN

CASE 2

Time Hour	Blood Sp. gr.	Serum Sp. gr.	Hgb. chart	Ser. prot. chart	Therapy	Remarks
	1.055	1.0555	4.5	6.3		Severe shock
6					200 c. c. alb.	Amputation performed BP 110/80
					300 c. c. bl.	Out of shock
					500 c. c. pl.	gms. Ca gluconate with bl.
7.5	0.51	0.573	17.5	7.0		Pr Satisfactory

The grams of calcium gluconate were given in doses between each liter of blood to prevent tetany due to the citrate in the blood.

The same scheme will be used on all subsequent tables. The zero hour represents the first time the patient was seen and appraised; Hgb. chart and ser. prot. chart represent the hemoglobin concentration in grams per cent and the serum protein concentration in grams per cent as taken from the Phillips and Associates chart; various intravenous fluids are abbreviated as follows: pl., normal plasma; conc. pl., concentrated plasma (3-4 fold); c. alb., concentrated albumin solution (1 per cent); bl., distilled whole blood (1 to 4 and to 5 dilution); D-5, 5 per cent dextrose in normal saline solution; D-H, 5 per cent dextrose in distilled water; at the time the quantity of intravenous fluid is designated in the table the administration has just been completed, having been started usually at the time the previous specific gravities were taken.

early but when compensation by the subjects' own resources is all that induces it the final degree of dilution of the blood may not occur for 24 to 36 hours (7). During the first hour the dilution may not exceed 10 per cent (13); indeed in occasional patients with hemorrhagic hypotension it has been reported that there may be no dilution or actual concentration of the red cells (hemoconcentration) (6, 15). The administration of intravenous fluid not containing red cells particularly protein fluids as plasma or albumin solutions by their inherent properties accelerates the development of the final degree of hemodilution in hemorrhage cases (17).

The extent of the drop in blood specific gravity, the effect on the serum specific gravity, the state of the blood pressure, the clinical picture, the response to therapy (including the quantity and quality of the fluids used) are all important in estimating a case of acute blood-loss clinically. Examples demonstrating the value of specific gravity studies will be divided into the patient (1) suspected of having a substantial hemorrhage (2) with hemorrhage with embarrassment to the circulation and (3) with hemorrhage followed by volume compensation (acute hemorrhagic anemia).

Following is an instance of a patient suspected of having a substantial hemorrhage

TABLE IV.—SPECIFIC GRAVITY VALUES IN

CASE 3

Time Hour	Blood Sp. gr.	Serum Sp. gr.	Hgb. chart	Ser. prot. chart	Therapy	Remarks
	1.045	0.5	0.5	3.5		
3					100 c. c. bl.	BP 110/80 Shock
3.5						115/80
5					600 c. c. bl.	
4.5					100 c. c. bl.	
5	0.5	0.55	3	6.3		

CASE 1. This patient sustained multiple lacerations involving the skin and muscles of the upper extremities back and legs; there was no fracture. He was seen about 4 hours after the injury. 250 cubic centimeters of normal plasma had been given intravenously. The specific gravity values were 1.054 for blood, 1.026 for serum, the blood pressure was 120-80 millimeters, hemoglobin, the pulse rate was 100 beats per minute, but the patient was restless; confused; the pulse was weak. Following 1,000 cubic centimeters of normal plasma by vein there was obvious clinical improvement and 7.5 hours later the specific gravity figures were 1.050 and 1.026. After 22 to 23 hours the specific gravities leveled off at 1.051 to 1.027, slightly lower than the normal range for the blood value.

The patient sustained injuries conducive to blood loss, the extent of which was unknown. The clinical improvement with plasma alone plus a stabilization of the blood specific gravity at levels only slightly below normal indicated a blood loss not of extreme proportions. Without the concentration studies complete confidence in this case would have been more difficult.

Hemorrhage with moderate to severe circulatory embarrassment. We are considering here the patient with tendency toward a lowered arterial pressure, weak pulse, restlessness or disorientation to coma, lowered urinary output, paleness with or without sweating, etc. following types of injury conducive to copious hemorrhages. Some have termed the state hemorrhagic shock (5); others prefer hemorrhagic hypotension applied to recoverable cases (22) while others object to applying the terms shock where simple hemorrhage appears to be the main complication (14). The demonstration of hemodilution by the copper sulfate method is our main concern at present.

TABLE V—SPECIFIC GRAVITY VALUES IN
CASE 4

Time Hour	Blood Sp. gr.	Serum Sp. gr.	Hgb. chart	Ser prot. chart	Therapy	Remarks
	0.415	1.025	8.5	6.8		
1.5					1000 c.c. D-5 500 c.c. pl.	D-5 pl. for urinary flow
80.5	0.42	0.95	8	6		
					50 c.c. bl.	
30	0.48	1.015	10.0	6.5		
32	0.40	0.95	11.1	6.5		
3.5					1100 c.c. bl.	
9.5	1.025	0.96	9	6.5		
50					150 c.c. bl.	
68	1.025	0.95	14.5	6		

CASE 2 The first patient sustained severe injuries to the right leg following an attack on one of our ships. He was seen some 8 hours later at which time there were clinical indications of severe circulatory embarrassment: pulse too weak to be definitely palpable, semiconscious, marked pallor, lowered skin temperature. The right leg was severely crushed and mangled and it was learned that the individual had been in the water (sea) some 45 minutes without a tourniquet before being rescued. Table III demonstrates marked hemodilution. Following the administration of concentrated albumin and whole blood (amount in table) there was much improvement, the right leg was amputated, additional blood and plasma were given and later the specific gravity of blood was only slightly below the normal range. The patient did well subsequently.

CASE 3 The second patient was seen 3 to 4 hours following the injuries, extensive shrapnel lacerations of the face, right arm, and right leg. The patient was weak, pale, cold, the pulse quite weak, the blood pressure 102/68. After 1100 cubic centimeters of whole blood there was much improvement but a total of 2,800 cubic centimeters of blood was required to elevate both blood and serum specific gravity values to near the normal ranges (Table IV). The patient improved and progressed nicely.

Hemorrhage with acute posthemorrhagic anemia This group includes the patients seen 2 to 3 days or longer following injuries producing blood loss and the final degree of hemodilution has been reached. At this time it is considered that an insufficient interval has elapsed in many cases for dietary and bone marrow depressing complications to affect the blood picture appreciably.

CASE 4. The first illustrative patient (Table V) was seen 2 days following the injury (gunshot wound

TABLE VI.—SPECIFIC GRAVITY VALUES IN
CASE 5

Time Hour	Blood sp. gr.	Serum sp. gr.	Hgb. chart	Ser prot. chart	Therapy
	0.40	0.92	8	5.5	
0.25	0.40				
1.0					1200 c.c. M.
3					1200 c.c. M.
24	1.047	1.025	11.5	5.45	
3					1200 c.c. M.
17					1200 c.c. M.
23	1.047	0.95	5	5	
4	0.95	1.055	14.6	5.5	

with abdominal perforation, injury to left kidney and spleen, emergency splenectomy.) The dilution of the red cells was prominent and it required 2750 cubic centimeters of whole blood given in 48 hours time to elevate the specific gravity to normal levels.

CASE 5 The second patient was likewise seen 2 days following the injury by shell fragments causing laceration of the abdominal wall and perineum, perforation of the urinary bladder and rectum. On this occasion, there was dilution of both red cells and serum proteins (Table VI). The specific gravity values returned to normal range following 4,400 cubic centimeters of blood.

BURNS

Early phase Here is included burn cases seen while there is increased permeability of capillaries giving rise to a decrease in the plasma volume and hemoconcentration (shock period).

CASE 6 The first patient was seen 8 hours following the burn (Table VII). He had received plasma intravenously prior to this time but the amount was not known. When seen there was pronounced concentration of the red cells as demonstrated by a blood specific gravity value well above the normal range. The extent of capillary damage and plasma volume depletion can be appreciated by the volume of protein solution required to lower the blood specific gravity to normal levels.

CASE 7 The second case is presented mainly because it reveals the highest blood specific gravity values seen. This patient came under our observation 4 hours after severe burns involving the entire body surface with the exception of about 50 per cent of the left arm and the area covered by swimming trunks. The left leg was parched, the foot blue and cold. The patient was in deep shock, unconscious, the pulse not palpable, the skin about the genitalia cold and prominent with bluish-gray mottling. The first blood samples (from femoral veins) were exceedingly thick and almost black in color (specific

TABLE VII.—SPECIFIC GRAVITY VALUES IN CASE 6

Time Hour	Blood Sp. gr	Serum Sp. gr	Hgb. chart	Ser prot. chart	Therapy
	1.058	.015	90.2	0.3	
8	.059	1.055	10	0	400 alb. pl.
10	1.059	.0155	15.0	0.2	500 c.c.b. 750 c. pl. D-H
14					800 c.c. c.b.
25	1.077	.0175	24.5	1.0	

gravity 1.074) The tremendous quantities of albumin and plasma required to control the hemoconcentration are given in Table VIII. The blood specific gravity returned to normal levels, the left foot became warm and pink, the patient regained consciousness. At no time was there evidence of pulmonary edema or right sided cardiac embarrassment (no venous engorgement). The first urinal specimen contained four plus albumin, red cells and casts. As soon as consciousness began to appear, troublesome retching with vomiting of blood began. The patient was reported to have died later aboard the evacuating ship. (With the patient so severely burned and without treatment for so long and in such extreme shock, it was decided to cope with the hemoconcentration regardless of the volumes needed so long as venous congestion or pulmonary edema did not become evident, as this approach seemed to give him his best chance.)

Later phase This group includes burn cases seen after 72 hours when anemia and hypoproteinemia begin to be prominent.

CASE 8 This patient had sustained burns involving about 40 per cent of the body surface of second and third degree types 5 days before. Plasma had been administered; the amount was not known. On admission the blood-serum specific gravities were 1.047 to 1.019. Following 500 cubic centimeters of concentrated albumin solution (75 grams albumin) 500 cubic centimeters of normal plasma and 1,100 cubic centimeters of citrated blood during the first day the specific gravity values became 1.045 to 1.0215. An additional 1,100 cubic centimeters of citrated blood were given and progress was being made in correcting the anemia hypoproteinemia complications when the patient was transferred for evacuation.

ANEMIA

An opportunity for the observation of specific gravity values in the anemia of malnutrition was afforded by a comparison of findings in a group of Javanese held by the Japanese as prisoners and utilized as laborers in Noemfoor

TABLE VIII.—SPECIFIC GRAVITY VALUES IN CASE 7

Time Hour	Blood Sp. gr	Serum Sp. gr	Hgb. chart	Ser prot. chart	Therapy	Remarks
	.074	1.058	22.5	1		
0.5	.07	1.065	1.8	0.7		
7					4.30 c.c. pl. 500 c.c. c.b.	gra. Ca. gluconate
8					.430 c. pl. 800 c. c.b.	gra. Ca. gluconate
10					1000 c. D-H	
15					600 c. c.b.	
9	30	.0165	2.7	0.7		Improvement evident
					1,150 c. pl.	
	37	.016	4.0	0.8		
5					1,000 c. D-H	
8						Transferred

Island (Geelvink Bay New Guinea) and the findings on their captors, members of the Japanese Imperial Army (Table IX). The Javanese were a group of miserable looking individuals markedly emaciated ('skin and bones' appearance) many too weak to walk, several displayed large tropical ulcers on the lower extremities. Through interpreters they gave the now stereotyped story of starvation in the midst of adequate food supplies and overwork impelled by brutal treatment. In

TABLE IX.—SPECIFIC GRAVITY VALUES IN ANEMIA OF MALNUTRITION

Subject	Blood Sp. gr	Serum Sp. gr	Hgb. chart	Hgb. Skell	Ser prot. chart
J. vaccine prisoner	.030	.01	2.5	6	4.8
Javanese prisoner	1.0505	.012	2.8	4.5	3.5
Javanese prisoner	.03	1.05	4.4	3.4	4.8
J. vaccine prisoner	.030	1.026	0.8	0.0	0.5
Javanese prisoner	3	.022	4	2.4	3.47
J. vaccine prisoner	18	1.024	0.0	7.3	2.8
Javanese soldier	1.053	1.015	12	14.5	0.5
Javanese soldier	.050	1.026	14.4	14.7	0.5
Javanese soldier	1.057	1.025	14	5.1	7.4
Javanese soldier	.057	.027	14.7	5.0	6.83
J. vaccine soldier	.0515	1.020	1.5	2.7	7.53
Javanese soldier	.09	.020	5	10.4	7.11

Artificial light as background. Amounts of plasma given were too small to effect significant changes in serum protein levels.

the same location the Japanese were robust and well fed. In the captives the specific gravity values were indicative of severe anemia and hypoproteinemia while in the Japanese captors the values were within the normal range. A correlation with the Sahli hemoglobin values was also obtained. Blood and plasma infusions were given to some of these patients but the amounts were too small to alter appreciably the specific gravity values.

The treatment of anemia is demonstrated in a patient with malaria

CASE 9. This person had not felt well for weeks and had been very ill for about 10 days prior to admission. An extraordinarily heavy infestation with *plasmodium falciparum* was noted on thick and thin blood smears. The patient was comatose and displayed a dry tongue and some loss of skin turgor. The dietary intake had been poor. The specific gravities (blood and serum) were 1.041 to 1.042 indicative of prominent anemia and hypoproteinemia. Following 1,000 cubic centimeters 5 per cent dextrose in saline, 1,000 cubic centimeters normal plasma 1,000 cubic centimeters citrated blood (21 1/2 hours after admission) the specific gravity figures were 1.047 to 1.043. An additional 1,500 cubic centimeters of citrated blood and 1,000 cubic centimeters of normal plasma were given (30 1/2 hours after admission) and 16 hours later the specific gravities were 1.050 to 1.053. At 59 hours the values were 1.051 to 1.0345. The patient improved markedly. The transfusions seemed to be a definite adjunct to the quinine and atabrine therapy in this case.

DEHYDRATION

If one considers that the clinical signs of dehydration (extracellular type with or without intracellular dehydration) are reliable then serious grades of dehydration have not been encountered as frequently in the wounded who have access to water as was expected. The clinical signs used include the urinary output and the specific gravity of the urine dryness of the mouth and skin thirst as expressed by the patient, loss of skin turgor and elevation of the specific gravity values of blood and serum. Of course the majority of the patients seen had sustained wounds of the extremities with or without fractures and could and would take sufficient water by mouth. Abdominal cases (intestinal perforation obstruction colostomy fistula cases) naturally presented more of a strict water

salt balance problem. One such case is presented.

CASE 10. This patient was seen 12 to 14 hours following the injury, shrapnel perforation of the abdomen. A loop of bowel and the surface of the urinary bladder had been injured. An emergency operation had been performed the bladder repaired and the loop of intestine brought to the surface (marsupialized). The loop had broken down and produced a fistula.

On admission the patient exhibited signs of severe circulatory embarrassment (shock) coma with periods of restlessness, pulse very weak, blood pressure 90/60 millimeters hemoglobin, pale, sweating, veins inconspicuous. The specific gravity values (blood—serum) were 1.058 to 1.0375, within the normal range. The shock was treated with citrated blood (1,600 c.c.) and normal saline (1,000 c.c.) by vein. There was definite clinical improvement, consciousness was regained, the blood pressure reached 100/75, the pulse was strong and regular but the patient had a ravenous thirst. There was loss of skin turgor and the urinary output was negligible. At this time (7 hours after admission) the specific gravity figures were 1.063 to 1.058, an elevation of the blood value, which indicated a moderate concentration. One liter of 5 per cent dextrose in saline and 250 cubic centimeters of normal plasma lowered the specific gravity value of blood to 1.053 (19 hours after admission) but it returned to an elevated value (1.061 to 1.058 by 37 hours after admission). At this time 2,000 cubic centimeters of dextrose-saline and 500 cubic centimeters of normal plasma were given and the values again dropped to 1.057 to 1.0375 at 41 hours. After an additional 500 cubic centimeters of normal plasma the values were 1.054 to 1.025. The patient was much improved, quiet but continued to ask for large quantities of water. The bowel continued to discharge copious quantities of fluid. Additional saline and plasma (1,000 c.c. and 500 c.c.) were given to replace that lost through the fistulous opening. After transfer this patient was reported to have done well.

Intravenous protein feeding. When plasma solutions are administered by vein largely for the dietary value of the contained proteins, specific gravity values may be of use. Should the patient be receiving 1,000 to 2,000 cubic centimeters of normal plasma daily (60 to 120 grams proteins) and no significant alterations are noted in the concentration values from day to day then one has a good idea that the administered solids and fluids are being utilized. A case in point was a patient with acute catarrhal jaundice and initial specific gravity values of 1.052 to 1.023. Eleven and one-half hours after 1,250 cubic centimeters of normal

plasma were given the values were 1.050 to 1.0255. An additional 1.250 cubic centimeters of normal plasma were given and later the specific gravities were 1.052 to 1.027.

EVALUATION OF STUDY

This study was begun by establishing normal values of whole venous blood and serum specific gravities for males of military age at sea level in a tropical climate. Then the ranges means and standard deviations were obtained. Significance was given to values outside of the range obtained by the mean $\pm 2\sigma$.

A comparison of the blood specific gravity values, the hemoglobin concentration as measured by Sahli's method and the red blood cell count gave a correlation similar to that obtained by Ashworth and Adams (1). Alterations in the specific gravity values as produced by various solutions given by vein gave results similar to results in other studies (2, 9, 10, 11).

Illustrations of the copper sulfate procedure as applied to the care of various types of abnormalities seen in battle casualties were presented. These concentration studies (specific gravity of blood and serum) were of great value in demonstrating trends in the make up of the circulating blood (hemodilution, hemoglobin concentration, anemia, hypoproteinemia, etc.) and to a great extent in demonstrating the severity of trends. In conjunction with the clinical picture (history, physical examination, etc.) the blood pressure level and the response to therapy they formed a valuable asset in the appraisal and therapy of the wounded.

CONCLUSION

The copper sulfate method for determining the specific gravities of blood and serum can be used to great advantage in the appraisal and treatment of various surgical conditions. Additional evidence supporting this conclusion has been presented. The method is of par-

ticular value in military use when several factors as the sudden arrival of large numbers of wounded men, the necessity of rapid decisions concerning the shock state, the appraisal of patients before anesthesia and operative procedures are instituted, the need for medical judgment during attacks by the enemy, make its simplicity, speed, degree of accuracy and instant applicability most desirable.

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LUMBAR APPENDICITIS AND LUMBAR APPENDECTOMY

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A SOMEWHAT rare form of appendicitis which may be mistaken for other conditions unless the symptoms are definitely understood, has not, to my present knowledge been clearly described. It is a type in which the appendix is posterior and lies against the peritoneum dorsal to or below the cecum. The general peritoneal cavity is not involved and the characteristic abdominal symptoms of appendicitis are absent. Without gross perforation and usually without intra abdominal pus formation, bacteria from the appendix penetrate the thin peritoneal layer and spread in the loose extraperitoneal connective tissue of the loin and pelvis, producing first a watery edema like that often seen in the deep tissues of the anterior abdominal wall from appendicitis, but with a much greater tendency to a spreading purulent, and necrotic process. The tela subserosa or extraperitoneal connective tissue of the posterior abdominal wall and pelvis is much more abundant, is looser, contains more fat, and is less resistant to infection than that of the anterior abdominal wall. There results from the lower involvement of the right extraperitoneal space a pelvic abscess, and from the upper type a right perinephritic abscess. Coincidentally inflammatory products within the appendix usually discharge into the cecum and the appendix undergoes resolution.

I have long believed that appendicitis without intra-abdominal suppuration is a common cause of the so-called idiopathic perinephritic abscess. This concept, however apparently has received little attention from urologists, although Hugh Young mentions appendiceal abscess as a possible cause of perinephritic abscess.

If an anterior abdominal incision is made in the early stages of lumbar appendicitis with removal of the appendix, the operator may encounter nothing to direct his attention to

the retroperitoneal inflammation. The peritoneum over the lumbar area is not necrotic or perforated and in the limited area not covered by the cecum, shows no greater inflammatory change than that usually found contiguous to an inflamed appendix. If careful palpation were made a cushion-like elevation of the peritoneum dorsal to the appendix might be detected but I dare say few operators have considered such examination necessary. With the lower type a large extraperitoneal pelvic abscess which later forms may be mistaken for and drained as a localized intraperitoneal collection. Likewise the operator will overlook the primary appendicitis when, without opening the peritoneum, he drains only the secondary retroperitoneal or perinephritic abscess. Apparently the septic extension through the peritoneum is uncommon if the appendicitis leads to a plastic or purulent peritoneal exudate. In other words, the extraperitoneal extension rarely is associated with a gangrenous or perforated appendix.

The signs and symptoms of the lower type of lumbar appendicitis are striking and, when fully developed very characteristic. The attack may start, as in the usual case of appendicitis with epigastric distress, nausea, moderate fever, elevation of the pulse rate, and polymorphonuclear leucocytosis. The pain tenderness, and rigidity however do not localize at McBurney's point but rather in the right lumbar muscles above the crest of the ilium. Medial to the right anterior superior spine of the ilium the signs of appendicitis, such as local tenderness, muscular rigidity and the iliopsoas and obturator tests, may be entirely absent. The patient however may complain of pain and tenderness over the anterior surface of the right thigh, of the right scrotum or in the female of the right labium majus. In the inflamed extraperitoneal connective tissue back of the cecum lie the genitofemoral nerve, the external spermatic branch of which innervates the cremaster and scrotal or labial skin, and the lum-

inguinal branch, supplying the skin of the upper anterior thigh. From involvement of the lateral femoral cutaneous and the femoral and obturator nerves symptoms referred to the lateral surface of the thigh, lower anterior surface or medial surface of the thigh, or knee also, may be produced. As the ureter runs through the intensely inflamed connective tissue, ureteral colic and hematuria may be present. The characteristic syndrome of lumbar appendicitis is lumbar pain tenderness and muscular tension associated with pain in the anterior right thigh, testicle or labium to which may be added vesical irritability and hematuria. A degree of lumbar scoliosis with concavity to the right may develop and later from the inflammatory exudate, the margins of the right psoas muscle may appear blurred or the muscle shadow obliterated on roentgen examination.

The pathological changes can be appreciated only by an incision exposing the extraperitoneal connective tissue in the right lumbar and iliac regions together with the appendix.

In operating an oblique incision is made above the crest of the right ilium along the fibers of the external oblique which are separated and partly divided. The retroperitoneal connective tissue space is entered and evacuated of the inflammatory exudate and wiped dry. The peritoneum is opened by a small incision behind or below the cecum through which the appendix is delivered. The meso-appendix is clamped and divided in sections and the base of the appendix doubly ligated and divided by a cautery between the clamps and beyond the ligatures. The meso-appendix is ligated over the stump of appendix in sections with one of the ligatures. As a rule the opening in the peritoneum may be closed with 36 gauge alloy steel wire and the septic retroperitoneal space drained the wound being closed about the drain with layer sutures of No. 32 wire. The retrocecal appendix lies against the peritoneum and is accessible from the loin.

The following is the report of a typical case of lumbar appendicitis.

Mr H B 22 years of age a medical student became ill in the afternoon with generalized dull

aching abdominal pain after eating Chinese food. At 6 o'clock the following morning he had a severe chill was nauseated and vomited and at 10:00 a.m. he entered the accident dispensary of Temple University Hospital with the diagnosis of a right urinary tract calculus as it was thought that the urine contained blood. At this time the hemoglobin was 13.5 (70 per cent) erythrocytes 5,030,000 color index 80 leucocytes 13,800 polymorphonuclears 83 lymphocytes 13 monocytes 3 eosinophiles 1 nonfilaments 51, filaments 31 urine clear, no sediment, acid, cloud of albumin much amorphous material, blood urea nitrogen 45 milligrams plasma carbon dioxide 0.50. The abdominal ache disappeared and there were several diarrheal movements. (A month previously he had had a transient acute abdominal attack with nausea, vomiting and constipation.)

In the afternoon he was transferred from the accident dispensary to the hospital with the impression that he had an acute gastroduodenitis and possible stone in the right kidney or ureter. His temperature then was 103.3 pulse 86 respiration 22 leucocytes 26,000 polymorphonuclears 89 nonfilaments 78 filaments 11 blood urea nitrogen 60 milligrams, urine 1.018 no casts or blood cells occasional leucocytes.

The patient a well developed and heavily muscled young man was seen in consultation about 4:00 p.m. He then was complaining of pain and sensitiveness in the lower right loin the anterior right thigh and in the right testicle. There was no abdominal distention muscle resistance or tenderness. Posterior to the line of the right anterior iliac spine and above the crest of the right ilium was a painful area with marked tenderness and increased muscular tension. With a diagnosis of retrocecal appendicitis and secondary lumbar phlegmon operation was performed about 4:30 that afternoon.

An oblique 9 centimeter skin incision was made about 2 centimeters above the right iliac crest. The fibers of the external oblique muscle were separated and the lumbar fascia and subperitoneal connective tissue (which were greenish seminecrotic, malodorous, and contained 60 to 90 c.c. of pus) were exposed. The area was mopped out and a 3 centimeter incision made through the peritoneum under the cecum exposing the appendix, which was swollen, injected and very lightly attached to the peritoneum but without perforation or plastic exudate. The peritoneal surface was moist from a very small amount of turbid odorless fluid. The base of the appendix was doubly ligated with No. 32 alloy steel wire, divided by cautery the meso-appendix ligated over the stump with one of the ligatures, and the peritoneal opening closed with fine wire sutures. The wound was lightly united with interrupted wire sutures around a drain extending extraperitoneally from the pelvis.

Pathologic report. The appendix measured 5 by 1 centimeter and was not perforated. The serosa was thickened and injected, the lumen narrowed but not obliterated. The mucosa was infiltrated by plasmato-

cytes lymphocytes, eosinophiles and neutrophiles, the epithelium lacking in many places and the glands replaced by fibrous connective tissue containing inflammatory cells. The picture was that of a healing acute appendicitis with evidence of a previous inflammatory attack. The day following operation the urine contained a few red cells and leucocytes.

The patient had an uninterrupted recovery and was discharged from the hospital 15 days after the operation.

SUMMARY

A type of appendicitis is described in which the inflamed organ has a posterior or retrocecal position, and from which the infection spreads through the thin contiguous peritoneal layer with little abdominal reaction and produces a spreading phlegmon or abscess in the poorly resisting loose areolar tissue of the retroperitoneal space in the right lumbar and pelvic areas. As the signs and symptoms are predominantly in the right lumbar region, I have termed the condition 'lumbar appendicitis'. The appendicitis tends to subside spontaneously probably largely by discharge of inflammatory products through the open lumen of the appendix into the cecum and is associated with so few characteristic symptoms as to be overshadowed in the later development of a perinephritic or pelvic abscess. In those cases in which the appendiceal symptoms are more definite the retroperitoneal extension may be diagnosed and

drained through the abdomen as a localized intraperitoneal collection.

The initial symptoms of lumbar appendicitis usually are abdominal colic, nausea and fever soon followed by pain, tenderness, and muscular rigidity in the loin, but with a degree of fever and possibly a chill unusual in acute appendicitis. This condition is to be attributed to the greater toxic absorption from the retroperitoneal space than from the peritoneum. Especially characteristic are symptoms due to the irritation of structures surrounded by the inflamed extraperitoneal connective tissue, as the right genitofemoral, lateral femoral cutaneous, femoral and obturator nerves and the ureter. The syndrome of pain, tenderness, and rigidity in the lower right loin with pain and tenderness referred to the right testicle and anterior part of the right thigh, occurring after a brief abdominal attack, is quite diagnostic.

In treatment it is important that the appendix be removed and the phlegmon drained through a lumbar or retroperitoneal approach otherwise the surgeon may remove an inflamed appendix and overlook the retroperitoneal phlegmon, or drain the pelvic or perirenal abscess and overlook the appendix. With removal of the appendix the peritoneum may be closed, or drained with the lumbar pelvic space through a single lumbar incision.

CORRECTION OF BLOOD LOSS DURING SURGICAL OPERATIONS

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THE study of blood changes produced by hemorrhage has received much attention in the past. Considerably less is known about the changes produced in the circulating blood by various types of anesthesia, the intravenous injection of fluids and the various exigencies of major surgical operations. These variables are so numerous that systemic consequences of traumatizing operations are not reflected in the circulating blood and the determinations of hematocrit, hemoglobin or plasma proteins give little information as to the quantity of blood lost or of pending shock. Support for this statement is found in a brief review of the literature and in the analysis of the blood changes of 35 patients undergoing major surgical operations to be presented.

Dyson, Plaut, and Vaughan observed the reactions to changes in the blood volume resulting from the removal of 540 milliliters of blood from 8 healthy donors in whom many of the variables were reduced to a minimum. They noted that in only one instance the change in blood volume as determined by the dye method was found to correspond to the calculated value. In the others dilution or overdilution was associated with an increase in mean corpuscular volume suggesting that some of the fluid replacing the blood lost was absorbed by the red cells. The authors also point out that blood loss may occur without affecting the hemoglobin level.

A rarely considered variable in the normal individual undergoing blood loss is the uncertain amount of blood expressed from the spleen. According to Lewis, Werle, and Wiggers, the spleen contracts vigorously during hemorrhage, and may shrink to a volume of 50 per cent or less of its original size. Wu in

1943 found the capacity of 20 spleens to vary from 60 to 400 milliliters, a volume which may be added to the blood volume during hemorrhage.

Thus it is evident that, even in simple uncomplicated hemorrhage in relatively normal individuals variable factors contribute to make changes in hemoglobin, plasma proteins, and hematocrit unpredictable. To these factors must be added the inherent differences present in each surgically sick patient and the various methods used in treatment. In general, surgical operations, anesthesia, shock, varying degrees of dehydration and malnutrition, fever, anemia, hypoproteinemia, and intravenous infusions of crystalloids, plasma and variable whole blood all contribute to changes in the circulating blood.

Windfeld, in 1937 made direct measurements of blood lost during operations and demonstrated that determinations of hemoglobin concentrations before and after operation failed to give quantitative information regarding the amount of blood lost.

Stewart and Rourke, recording the changes in the volumes of blood and interstitial fluid during operations under ether anesthesia, stressed the fallacy of assuming a quantitative relationship between changes in concentration of hemoglobin or plasma proteins and changes in plasma volume. From their observations reduction in plasma volume may be greater than can be accounted for by hemorrhage.

Ariel, Pack, and Rhoads compared liver biopsy specimens secured at the beginning and the end of gastric operations and found that hepatic cells usually swell during surgery. The average increase in total liver water was 11 per cent. By inference, the red blood cells also may take up some of the fluid transferred from the interstitial space to the blood stream.

In March 1945 Evans published conclusions resulting from the recent studies of three

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TABLE I.—BLOOD LOSS AND CHANGES IN HEMATOCRIT, HEMOGLOBIN AND PLASMA PROTEINS IN OPERATIONS ON THE THYROID

Patient number	Age and sex	Weight kgm.	Duration, min.	Hypertension	Fluids, ml.			Blood loss			Hematocrit volume per cent. Percentile change, preoperative determination	Hemoglobin gm. per cent. Percentile change, postoperative determination	Plasma protein gm. per cent. Percentile change, postoperative determination
					5 per cent. Glucose	Saline	Blood	ml.	Per cent. total blood volume	Per cent. coagulated			
	53-F	43	110*		1400			434	- 8.3	- 8.3	34.6 - 0.9	13 - 1.1	6.25 1
2	24-M	47	58*					476	- 7.5	- 7.5	46.4 - 10	15.6 - 10.3	7.25 - 7.6
9	44-F	66	140*		1000			400	- 9	- 9	6 - 7	11.6 - 6	7.25
	61-F	15	93*		000			304	- 5.3	- 5.3	46 - 6	14.8 - 6.6	6.25 1
5	58-M	84	1*		1000			389	- 6	- 6	34.4 - 6.9	7	7.25
166	3-F	39	62†		1000			725	- 17.8	- 17.8	41.4	3 - 3	7.25
60	3-F	19	1		1000			683	- 46.4	- 46.4	39.5	13 - 6.6	6.25 - 1
Average percentile change										- 19.7	- 5	- 4.4	- 1

*Trifluoroacetic acid, nitrous oxide and ether

†Trifluoroacetic acid, nitrous oxide, local anesthetic

separate shock research groups (of New York, of Atlanta, and of Richmond) in which estimations of blood volume were made by means of the dye method. He presented simple reasons why the determination of hemoglobin and plasma proteins does not suffice in estimating the blood volume in surgical patients. He pointed out that "in whole blood loss almost equal quantities of red cells and of plasma are missing so that hemoglobin and plasma protein concentrations will be relatively unchanged and the surgeon is given a false sense of security. In situations when moderate quantities of red blood cells and much plasma are lost, there will be hemoconcentration yet there is no indication of red cell loss. Only in situations of relatively simple plasma loss (such as peritonitis and some burns) will hemoglobin and hematocrit give an accurate picture of the trend of blood volume alterations."

Introduction of intravenous fluids further complicates the picture. Although Bogert, Underhill, and Mendel found, in 1916 that the blood volume of rabbits injected intravenously with saline returned to normal 30 minutes after the injection later investigations have shown that alterations in blood volume following intravenous infusions last

much longer. Gilligan, Altschule, and Volk found that the blood volume increases after intravenous fluids may not return to the normal level for 2 hours.

The blood at the end of operation is thus the resultant of these variable influences, and it becomes impossible to select any one chemical determination indicative of the condition of the postoperative patient, unless it is the determination of the plasma volume, a laborious and often unsatisfactory procedure in the seriously ill patient.

In support of this statement, the data compiled from the determinations of hematocrit, hemoglobin and plasma proteins of 35 patients before and after major surgical operations are presented in Tables I through VI. In each instance the preoperative value is recorded and below it the percentile change from the preoperative value obtained at the end of operation. The blood lost at operation was determined and has been reported elsewhere (4). Heparinized blood was used, and a 2 milliliter sample sufficed for the 3 determinations. Hematocrit was measured in sealed, capillary tubes spun until no further change in cell volume occurred. Hemoglobin was analyzed as oxyhemoglobin by the photoelectric method of Evelyn on 20 cubic mill-

TABLE II.—BLOOD LOSS AND CHANGES IN HEMATOCRIT HEMOGLOBIN AND PLASMA PROTEINS IN MASTECTOMY

Patient number	Age and sex	Weight kgm.	Duration, min.	Hypotension	Fluids, ml.			Blood loss			Hematocrit volume per cent Percentile change, postoperative determination	Hemoglobin gm. per cent Percentile change, postoperative determination	Plasma proteins gm. per cent Percentile change, postoperative determination
					% per cent Glucose	Saline	Blood	ml.	Per cent total blood volume	Per cent corrected			
1	39-F	97.7	147*	+	000			857	- 8	- 8	43.3 - 3	13.5 - 3.3	7.27 - 0.7
3	61-F	64	143*		000	00	30	670	- 3.8	- 8.7	43.9 - 3	13.6 - 3	7.04 - 2.6
17	6-F	85.0	240*	++	800	800	450	214	- 7.8	- 8.3	47 - 3.3	18.6 - 14.7	7.3 - 3
10	34-F	33	168*	0	1300			339	- 14.6	- 14.6	43.3 -	13 - 8.9	7.86 - 7.3
40	55-F	63.0	15*		1000	3	275	09	- 23.8	- 9.4	43.7 -	13.3 - 3	8.14 - 6.3
Average percentile changes									- 7.4	- 8	- 3	- 13	- 8

*Nitrous oxide, oxygen and ether

meters of well mixed blood measured in the falling drop pipet with the aid of a Guthrie pipet holder. This procedure was adopted to avoid the inaccuracies of the 20 cubic millimeter blood pipet. Plasma proteins were determined by the method of Barbour and Hamilton and by the use of Weech's formula. Hemolyzed plasmas were corrected for hemoglobin by an adaptation of Evelyn's method before the plasma proteins were calculated from the plasma specific gravity.

Table I is concerned with the changes occurring during thyroidectomies. In this group only 1 patient received no intravenous fluid. This patient (3) lost 227 milliliters of blood or 7.5 per cent of his total blood volume.¹ A comparison of the percentile changes of both hematocrit and hemoglobin (-10.1 per cent and -10.3 per cent, respectively) and the calculated blood loss (7.5 per cent) indicates an overdilution, similar to the reaction of healthy donors to the withdrawal of blood.¹

All the other patients in Table I received 5 per cent glucose intravenously during the operation. Patient 10 with a blood loss of 204 milliliters or 5.3 per cent showed little or no tendency to hemodilution above that of the blood lost, in spite of 1000 milliliters of glucose infused during the operation. In other words, approximately 750 milliliters of fluid have left the blood stream during the operation.

¹Total blood volume was calculated from the average values determined by Osborn and Evans, 77.7 milliliters per kilogram of body weight in the male and 60 milliliters per kilogram in the female.

In contrast, patient 15 showed changes in hematocrit (-5.9 per cent) comparable to the blood loss (-6.0 per cent) but both hemoglobin and plasma proteins remained unchanged. This instance suggests an absence of hemodilution and even a shrinkage of the red cells.

Patient 16 was operated on for a very large toxic goiter. In spite of the large blood loss of 725 milliliters, 28 per cent of the total blood volume and the infusion of 1000 milliliters of glucose there was no evidence of hemodilution. Later patient 16b during the second stage of the hemithyroidectomy showed a similar reaction. These findings suggest the rapid disappearance of the intravenous fluid and the absence of hemodilution after large losses of blood.

Table II presents the results of studies during radical mastectomies. Patient 1 received 1000 milliliters of glucose during the operation which involved a blood loss of 821 milliliters or 12.8 per cent of the total blood volume. She developed mild hypotension. The percentile change in hemoglobin (-15.3 per cent) corresponded to the blood loss (-12.8 per cent). The hematocrit change (-2.3 per cent) is rather indicative of increase in mean corpuscular volume.

In patient 29 with a loss of 14.6 per cent of the total blood volume, the change in hemoglobin (-18.9 per cent) and in plasma proteins (-17.3 per cent) corresponds to the blood loss with a tendency toward overdilution while

TABLE III.—BLOOD LOSS AND CHANGES IN HEMATOCRIT HEMOGLOBIN AND PLASMA PROTEINS DURING COMBINED ABDOMINOPERINEAL RESECTIONS

Patient number	Age and sex	Weight kgm.	Duration, min.	Hypotension	Fluid, ml.			Blood loss			Hematocrit volume per cent Packed cell volume, postoperative determination	Hemoglobin gm per cent Packed cell volume, postoperative determination	Plasma proteins gm per cent Packed cell volume, postoperative determination
					3 per cent Glucose	Balance	Blood	ml.	Per cent total blood volume	Per cent corrected			
7	60-M	58	07 ^a	++	1800			183	-4	-4	38.4 +10.7	13.6 -7.6	7.11
3	57-F	68	180 ^a		1800			41	-0	-0	45.7 -12.4	14.6 -10	6.46 12.6
7	68-31	58	145 ^a		600	400	430	213	-13.6	-0	41.8 -5.6	13	7.12 -4
8	61-F	58	85 ^a		900	300	430	210	-5.3	-2	41.3 -7	13.3 -5.3	6.46 -4.5
41	40-M	48.9	200 ^a	+	1800		430	474	-13.3	-0.8	30.8 -10.8	13 -3.3	6.58 -4
14	70-31	57	11+	+	080	800	300	080	-5.3	-10.3	47 -2	14 -6.3	7.41 -4.2
16	60-F	51.7	10 ^a	+++	1000	300	33	447	-7	-3	47.8 -7	3 -7.8	7.38 -7.6
30	48-F	7.8	145†		1800			404	-30.4	-4	37.6 -13.8	10.7 -14	7.06 14
24	73-31	27.3	36†	+	900	30	400	233	-3.8	+4	47 -6	14.7 -6.8	6.60 -4.5
36	34-F	61.7	85 ^a		1000		430	453	-1.6	-1	30.8 -3.8	17.3 -4.4	6.56 1
18	19-31	76.0	115†	+	700	400	370	378	-0.8	+3	30 +3.0	10.8 +6	6.50 -9
43	48-31	64	166†	+	1700	16	3	306	-6	-2.7	47.7 -10.7	13.6 -12.6	6.46 1
Average percentage change									-3	-3	-3	-3	-4.5

^aContinuous spinal, procaine
†Spinal, sucrinase

the hematocrit (-11.1 per cent) is indicative of cellular swelling.

In these mastectomies the changes in hemoglobin compared more closely with the blood loss than did the changes in hematocrit or plasma proteins. However even the hemoglobin changes are often misleading. Blood losses were large averaging 800 milliliters and hypotension occurred frequently.

Patients undergoing combined abdominoperineal resection for carcinoma of the rectum are represented in Table III. Here the average changes in hematocrit (-5.1 per cent) hemoglobin (-8.0 per cent) and plasma proteins (-6.6 per cent) correspond fairly well with average blood loss (-3.2 per cent) but suggest a tendency toward overdilution. Individually this ideal correlation exists in only one instance, patient 30. The other cases show considerable variation. For example patient 7 sustained a blood loss of 183 milliliters (4.1 per

cent) of the total blood volume. This patient's reaction to the small loss of blood was a change in hematocrit of +10.7 per cent, in hemoglobin of -17.6 per cent and in plasma proteins of -1.1 per cent. A fairly pronounced hypotension may have been responsible for some of these shifts.

Difficult and prolonged surgery for diseases of the biliary tract provided the cases in Table IV. In these patients hypotension is frequently a prominent part of the surgical picture. In spite of the existing marked hypotension patient 18 presents blood changes comparable to the hemodilution resulting from a blood loss of 8.1 per cent. On the other hand patient 21 after a corrected blood loss of 14.4 per cent (total loss less transfusion during operation) showed a hematocrit change of -4.5 per cent, a hemoglobin change of +1.5 per cent, and a plasma protein change of -11.1 per cent.

TABLE IV—BLOOD LOSS AND CHANGES IN HEMATOCRIT HEMOGLOBIN AND PLASMA PROTEINS DURING SECONDARY AND PLASTIC OPERATIONS ON THE BILIARY TRACT

Patient number	Age and sex	Weight kgm.	Duration, min.	Hypotension	Fluids, ml.			Blood loss			Hematocrit volume per cent	Hemoglobin gm. per cent	Plasma proteins gm. per cent
					% per cent Glucose	Sa-line	Blood	ml.	Per cent total blood volume	Per cent coag rected	Per centile change, postoperative determination	Per centile change, postoperative determination	Per centile change, postoperative determination
11	50-F	61	105*		1000		0	253	-3.0	-3.9	46.6 -3	15.0 -0	7.58 -0
14	54-M	90.3	30*	+	600	60	340	41	-8	-8	43.1 +14.6	14.3 +	7.42 +8
1	51-M	74.6	51*	+++	1200	375	65	2433	-27.5	-14.4	40.4 -4.5	13.6 +	8.40 -1
	50-M	81	3*		1000	200	270	84	-3.8	-4	51.0 +3.8	16.8 +3.6	7.55 +9
18	68-M	65	85*	++	1000			406	-8	-8	50.8 -4.8	16.6 -7.1	7.80 -6
19	5-F	7	60*		2000			257	-6	-8	44.5 +5.6	14 -7.0	7.86 +1.4
20	54-F	41.8	150*		500	5	80	454	-16.4	-6.5	40.8 +9.8	13 -0	7.03 -5
41	51-F	30.3	120*	++++	50	50	480	1065	-41	-22.6	44 -5.7	14.8 -14.9	7.45 -
Average percentile change: biliary tract										-8	+1.5	-4.8	-4

*Nitrous oxide, oxygen and ether

TABLE V—BLOOD LOSS AND CHANGES IN HEMATOCRIT HEMOGLOBIN AND PLASMA PROTEINS, DURING OPERATIONS FOR COMPLICATED GASTRIC LESIONS

Patient number	Age and sex	Weight kgm.	Duration, min.	Hypotension	Fluids, ml.			Blood loss			Hematocrit volume per cent	Hemoglobin gm. per cent	Plasma proteins gm. per cent
					% per cent Glucose	Sa-line	Blood	ml.	Per cent total blood volume	Per cent coag rected	Per centile change, postoperative determination	Per centile change, postoperative determination	Per centile change, postoperative determination
6	62-F	59.6	285*	+++	3000			533	-14	-14	40.5 +12.4	13.7 -5	6.60 +12.3
8	63-M	58	270*		300	700	900	804	-30	+4	41 +8.5	13.7 +4.4	5.99 +7
21	50-M	60.0	55*		1000			3	-6.8	-6.8	47.3 +3	13.7	6.46 +7.7
Average percentile change: gastric lesions										-6	+7	+	+7.6

*Nitrous oxide, oxygen and ether

TABLE VI.—SUMMARY

Operation	Number cases	Average blood loss			Average percentile change		
		ml.	Per cent	Per cent*	Hematocrit	Hemoglobin	Plasma protein
1. Thyroidectomy	6	371	-7	-7	-5	-4.4	-3
2. Radical mastectomy	3	808	-7.4	-8	-5	-12	-8
3. Combined abdominoperineal resection	41		-9.5	-3	-5.1	-8	-6.6
4. Biliary tract	8	504	-14.6	-8	+1.5	-4.8	-4
5. Gastric lesions	2	529	-13.8	-6	+7	+	+7.6

*After replacement of blood during the operation.

As mentioned before Pack and associates (1) demonstrated swelling of liver cells in patients following operation on the stomach. The cases presented in Table V show evidence of swelling of red blood cells as shown by the increased hematocrit.

Table VI summarizes the average blood losses and the average changes in hematocrit, hemoglobin and plasma proteins. Blood losses calculated from the changes in hematocrit, hemoglobin, or plasma proteins would lead to an underestimation of the need for replacement in mastectomies thyroidectomies, biliary tract surgery and gastric lesions. In combined abdominoperineal resections, the individual estimates would also be uncertain in spite of the fact that the average values shown in the series correspond fairly well to the blood lost.

COMMENT

Thus, an analysis of the findings in the 35 cases here presented furnishes further evidence that no easy practicable laboratory procedure will indicate the status of the circulating blood in the postoperative patient.

Studies of blood loss invariably show that the loss is almost always greater than the surgeon estimates. It is becoming widely recognized that the only wholly suitable replacement for operative blood loss is whole blood and that the greatest benefits result when the blood is given as the loss occurs.

The surgeon therefore, should plan in advance for the adequate replacement of the deficiency caused by bleeding during the operation. To do this, he must usually rely upon his own knowledge of the amount of blood loss to be expected in each case. Recognizing this fact the present authors, in a previous publi-

cation (4) tabulated the average blood losses occurring during the usual types of operations as calculated from 626 cases reported in the literature.

CONCLUSIONS

Whole blood is required adequately to replace blood lost during surgical operations. The replacement is most effective when whole blood is given as the loss occurs.

The amount of blood needed in each surgical case can seldom be determined directly. Hemoglobin, hematocrit, and plasma protein concentrations fail as an accurate measure of this need. Plasma volume determinations are more accurate, but are too laborious and time consuming for routine use.

A knowledge of blood loss during operation as available in the literature offers a practical basis for planned transfusions during operation.

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PATELLECTOMY IN THE MILITARY SERVICE

A Report of 19 Cases

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THE subject of patellectomy or complete excision of the patella has long been a controversial one. Those opposing the procedure argue that if the patient regains complete flexion of the knee there is resulting limitation of extension and conversely if he has complete extension he cannot fully flex the knee (Fig 1a b).

We believe that patellectomy can be a very successful operation and that patients with complete patellectomy can have normal knee function. Many operations have been devised for this procedure each claiming some special advantage. We carry no banner for any particular operation, but believe only that the essential aim should be to eliminate the slack in the quadriceps tendon which is created when the patella is removed.

The amount of slack to be eliminated has not been adequately defined in the literature. Consequently we have herein attempted to clarify the subject on a mathematical basis, although realizing that the figures used are averages and do not apply to any given case. For purposes of the computations we have accepted 2 centimeters as the average thick-

ness and 5 centimeters as the average length of the patella, and we have further assumed that the quadriceps tendon drops the entire 2 centimeters when the patella is removed (which is not entirely true in view of the thickness of the quadriceps tendon itself). We have computed that this portion of the quadriceps tendon becomes lengthened to about 6.4 centimeters or a gain of about 1.4 centimeters.

Since muscle power is directly related to the length of the individual fibers and hence to overall contractile length it can be readily seen that a gain in length of $1\frac{1}{2}$ centimeters would be disastrous to function both in strength of the quadriceps and in range of extension of the knee. This point has not been adequately clarified and for this reason we insist that the elimination of the slack is the important principle in the operation and that it makes little difference whether the patella is reached through a transverse parapatellar or other approach.

The operation we have used is as follows (Fig 2). The patella is approached through a short median parapatellar incision. A straight longitudinal incision is made through the quadriceps expansion in the midline of the

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Fig 1. Patient A.L., aged 24 years. Chondromalacia patellae of right knee. a and b, Photographs made 8 weeks

after operation demonstrate restoration of full range of extension and flexion.

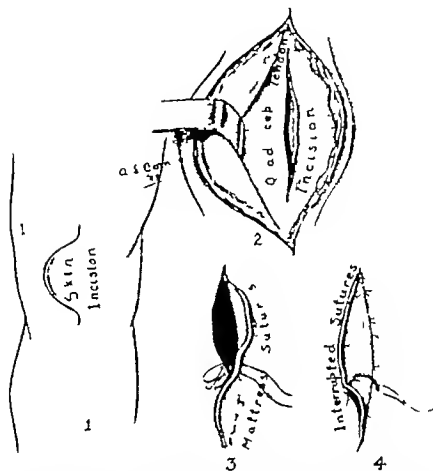


Fig. 2. Incisions and method of lateral plication. 1, Median parapatellar skin incision. 2, Longitudinal incision of quadriceps tendon in middle of patella. Patella partially exposed with beginning undermining of tendon anteriorly. 3 and 4, Patella exposed. Lateral plication performed with knee in full extension, by use of No. 00 black silk mattress sutures.

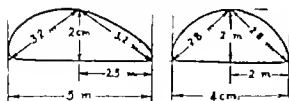


Fig. 3. (a) The arc is assumed to equal its chord. Application of Pythagorean theorem shows chord to equal the square root of 0.25 or 0.5 , and the length of the quadriceps tendon then is 6.4 centimeters, or 0.4 centimeters longer than the patella. (b) The same assumptions apply; the chord in this case being 0.3 and the width of the quadriceps tendon then is 5.6 centimeters or 0.6 centimeters wider than the patella. It is to be noted that the figure for longitudinal slack— 4 centimeters—bears no relation to the figure for lateral plication, 1.6 centimeters.

patella, extending 1 centimeter above and below the limits of the bone. The expansion is then removed by sharp dissection left as intact as possible and the patella is removed after cutting through the synovial attachments. The quadriceps tendon is then plicated laterally a distance of 1.6 centimeters at the midpoint and tapering toward both ends. This figure is arrived at as before by assuming the thickness of the patella as 2 centimeters, the width as 4 centimeters, and the slack to be eliminated being computed as 1.6 centimeters (Fig. 3). In actual practice if one merely plicates all the available tissue in the lateral direction without tension the result will be the same. However this plica-

TABLE I—CLINICAL RÉSUMÉ OF 19 CASES OF PATELLECTOMY

Pa- tient	Age years	Injury	Infection	Duration symptoms preoperative	Postoperative period evaluated up to July 1, 1945	Function		Symptoms	
						Preoperative	Postoperative	Preoperative	Post operative
	20	Fracture comp. commin.	N	8 mos.	3 mos.	Normal	Normal	Pain, swelling	N
	3	Fracture comp. commin.		6 wks.	6 mos.	80-100	80-90	Pain, swelling	No
	3	Fracture comp. commin.	N	5 1/2 mos.	3 mos.	70-90	150-90	Marked pain, swelling	N
	20	Fracture comp. commin.	N	9 mos.	1 1/2	80-90	80-90	Pain, grating	No
		Fracture comp. commin.	N	3 mos.	6 mos.	70-90	80-95	Pain	N
		Fracture comp. commin.	No	7 mos.	4 ks.	80-	50-90	Pain, grating	N
	24	Fracture comp. commin.		4 1/2 mos.	4 wks.	80-55	80-90	Pain, grating	N
		Fracture comp. commin.	non- (packed open)	3 1/2 mos.	3 mos.	50-80	80-90		N
	3	Fracture comp. commin.	N	3 mos.	7 wks.	80-90	80-90	Pain, grating	N
	30	Fracture comp. commin.	N	day	7 mos.	Normal	80-90	Instability, round	No
	34	Chondromalacia	N	3 mos.	non	80-70	80-40	Pain, slight instability	N
	34	Chondromalacia	No	4 mos.	3 1/2 mos.	80-60	80-40	Pain, swelling instability	N
	35	Chondromalacia	N	non	1 1/2 mos.	80-45	80-5	Pain, swelling instability	N
	30	Chondromalacia	No	7 mos.	8 ks.	80-45	80-60	Pain, stiffness	N
	30	Chondromalacia	N	3 mos.	4 wks.	80-60	80-40	Pain, stiffness swelling	N
	30	Chondromalacia	N	5 1/2 mos.	4 wk.	80-45	80-40	Instability, grating	N
	35	Chondromalacia, near lateral infrapatellar	N	3 yrs.	wks.	Normal	80-40	Instability, grating locking	N
	30	Dislocation chondromalacia	No	4 mos.	9 ks.	75-90	80-70	Pain, grating	N
	3	Fracture, simple nonunion	N	3 1/2 mos.	non	105-90	80-40	Pain, at times	N

tion must be performed with the knee in full extension since in flexion the slack will be loosened and the computations made become invalid. The plication is done with No. 00 silk, reinforced with single sutures. The subcutaneous tissue and skin are closed as usual.

Postoperatively the patient is immobilized in balanced suspension with the knee in full extension for 1 week and is then started on active exercises. Quadriceps setting is begun in 24 hours. Patients can usually begin weight bearing within 2 weeks.

The conditions for which patellectomy is most often indicated are recent comminuted

fractures, old fractures with roughening of the articular surface of the patella or femoral condyles, chondromalacia patellae and dislocations, habitual or recurrent of traumatic paralytic, or congenital origin. In addition removal of the patella may be indicated in the treatment of degenerative arthritis, local septic lesions and tumors of the patella.

CLINICAL MATERIAL

Nineteen total patellectomies are now available for study data are presented in Table I.

In patients with chondromalacia patellae as the underlying pathological process there

has been a normal range of motion preoperatively but with associated knee joint symptoms. Postoperatively in all cases, there has been a rapid recovery of normal motion with a subsidence of all symptoms.

In those cases in which there has been limitation of joint motion preoperatively as in the compound fractures there has been a definite improvement in the range of motion although normal motion has not been attained. We believe that in these cases failure of return of normal motion is due to associated intra articular damage found in all cases on the roentgenograms and at the time of surgery. In this respect it is noteworthy that there was normal motion preceding and following patellectomy in patient M J with a comminuted fracture of the patella due to a perforating bullet wound in whom there was no demonstrable associated joint damage. All patients have been relieved of their knee joint symptoms and excellent function has resulted in spite of the limitation of motion.

We have concluded that whereas in all cases the patient is alleviated of his knee joint symptoms and has shown an improvement in or normal restoration of motion *this postoperative return of joint motion has been*

conditioned by the range of motion existing prior to surgery

CONCLUSIONS

1 While we hold no brief as to the incision used for removal of the patella, we believe that the median parapatellar skin incision and the longitudinal incision of the tendon are best adapted to the method of lateral plication.

2 The slack to be eliminated by the method of lateral plication has been computed to be 1.6 centimeters with the knee in full extension.

3 In this series of 19 patellectomies, (10 compound comminuted fractures, 8 cases of chondromalacia and 1 ununited simple fracture) all patients have been relieved of knee joint symptoms.

Whereas all patients have shown improvement in or normal restoration of function, postoperative return of function has been conditioned by the range of motion existing prior to surgery. Those patients who have had a normal range of motion before surgery will regain a normal range of motion following removal of the patella. Those patients with limited motion preoperatively due to associated joint damage have shown a measurable improvement in range of motion.

BRONCHOPNEUMONIA FOLLOWING ETHER ANESTHESIA IN OBSTETRICS

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A SERIES of cases of bronchopneumonia has been observed in patients on the obstetrical service at Cleveland City Hospital. These bronchopneumonias observed within a few days following delivery were variable in extent, transient in nature, and were not associated with clinical evidence of serious illness. They were discovered in almost all cases by means of a roentgenogram of the chest made to investigate the significance of slight fever or rales in the chest developing after delivery. The anesthesia in these cases consisted of ether administered usually by the open method and preceded by varying quantities of barbiturate and other premedication. The mechanism by which the pneumonias were produced was probably the aspiration of mucus or vomitus during or following anesthesia. Other factors which may be considered are suppression of cough reflex and retention of secretions due to the irritation of ether.

Further study of these cases was undertaken because of the frequency with which they were observed and because some of them were incorrectly diagnosed.

REVIEW OF LITERATURE

A search of the literature revealed that little attention has been paid to aspiration pneumonia as a complication of anesthesia in obstetrics. Hall in 1940 called attention to aspiration pneumonitis as an obstetric hazard by reporting 15 cases of aspiration pneumonia following delivery. His cases were of a serious nature, since 5 died and several others required prolonged hospitalization. He commented that the aspiration of solid material into the trachea or bronchial tree might produce death from respiratory obstruction, while the aspiration of fluid material produced some

sort of chemical pneumonitis. He discussed a number of factors including diet prior to delivery, position of the patient during anesthesia, and premedication which he thought might be related to the problem of aspiration of gastric contents. Autopsies were obtained in 2 of his 5 fatal cases. One showed both lungs full of a diffuse wet consolidation with air present only at the extreme apexes. The second was found to have both lungs collapsed and the bronchi of each lung filled with dark colored contents, apparently spinach or some other dark food.

Meurlin in 1941 reported a series of 7 deaths occurring in Essex County, New Jersey, in a period of 4 years, developing during or soon after labor and directly caused by the aspiration of stomach contents. He stated that in addition to these 7 cases, many other deaths had occurred which were probably also of this nature, but which were not included in his report due to lack of accuracy of the available information or because of their controversial nature.

SUMMARIES OF TYPICAL CASES

CASE 1. V. M., a white woman 25 years of age, was admitted to the tuberculosis division of City Hospital on August 26, 1934. Four days prior to her admission, following a labor of 15 hours' duration, she was delivered of a healthy infant at a maternity hospital elsewhere in the city. Ether anesthesia was administered for 40 minutes, preceded by seconal medication and was followed by vomiting. Evidence of bronchopneumonia appeared and on the day following delivery she was transferred to a general hospital. At this hospital a roentgenogram of the chest made 2 days following admission showed irregular mottled and feathery shadows of increased density distributed symmetrically throughout all of both lung fields. Since the radiologist interpreted these changes as due to pulmonary tuberculosis, the patient was transferred to the tuberculosis division of City Hospital. On admission she was afebrile, did not appear ill, but presented scattered inspiratory musical rales bilaterally. The admission roentgenogram of the chest, made 6 days following delivery again showed diffuse bilateral mottled infil-

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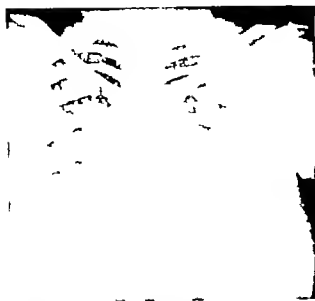


Fig. 2 Case 2. Extensive patchy symmetrical bilateral bronchopneumonia.

tration less extensive than that observed on the submitted roentgenogram. Because of the symmetry of her pulmonary disease, the healthy appearance of the patient, and the absence of pulmonary symptoms, pulmonary sarcoidosis was suspected. Another roentgenogram of the chest made 10 days following admission showed the pulmonary infiltration to have undergone complete resolution. Since the rapidity of clearing of the infiltration excluded both pulmonary tuberculosis and sarcoidosis, it was evi-



Fig. 3 Case 4. Dense bronchopneumonic infiltration in right upper and lower lung fields.



Fig. 5 Case 5. Dense coalescent infiltration involving lower two-thirds of right lung field, and left hilum.

dent that the process represented a widespread bronchopneumonia. The patient was discharged on September 16, 1944, to the care of a private physician.

CASE 3. F. N., a colored woman 22 years of age, was admitted to the obstetrical service on March 15, 1944, in active labor. Secoval was administered in a dose totalling 3 grains as premedication. Delivery was effected following a labor of $3\frac{1}{2}$ hours' duration. Ether anesthesia was employed. Vomiting of particulate and fluid gastric contents occurred during and immediately following anesthesia. Dyspnea and cyanosis developed. Bronchoscopic aspiration was immediately performed with relief of dyspnea, followed by the administration of sulfathiazole for a period of 3 days. The temperature rose to 38.5 degrees Centigrade for a period of 1 day after which it remained normal. Scattered rales were present throughout the chest. The total white count on the day following delivery was 12,800 white cells per cubic millimeter. A roentgenogram of the chest made 1 day following delivery showed the presence of coalescent, poorly demarcated shadows of increased density distributed symmetrically throughout both lung fields, interpreted as bronchopneumonia. Following the initial episode of obstructive dyspnea, the patient did not show evidence of serious illness. A second chest radiograph made 8 days following delivery showed complete resolution of the bronchopneumonia. She was discharged April 3, 1944, 11 days following her hospital admission.

CASE 5. D. T., a white woman 27 years of age, was admitted to the delivery room on March 11, 1944. Delivery was effected following a labor of 17 hours' duration. Inhalation gas oxygen ether anesthesia was used, preceded by morphine and scopolamine medication. The anesthesia was complicated by

TABULAR SUMMARY OF 20 CASES

	N cases
Extent of involvement	
One lobe or less	13
One lobe to one lung	5
Exceeding volume of one lung	2
Side involved	
Right	15
Left	2
Bilateral	3
Localization in lung field	
Upper	0
Lower	4
Midlung	6
Upper and lower	6
Involvement chiefly of right upper lobe	8
Density of infiltration	
Slight	12
Marked	8
Type of anesthesia	
Ether cone	15
Oxygen ether	3
Unknown	2
Preliminary medication	
Barbiturate	8
Morphine and scopolamine	4
No sedative medication	6
Unknown	2
Time of last meal	
Less than 6 hours before anesthesia	2
Over 6 hours before anesthesia	16
Unknown	2
Fever duration	
No fever	1
Fever 1 day	0
Fever 2 to 3 days	9
Fever over 3 days	2
Unknown	1
Fever height	
No fever	1
37 to 39 degrees Centigrade	11
39 to 41 degrees Centigrade	6
Unknown	2
Known to have vomited	9
Bronchoscopy performed	1
Chemotherapy	
Administered	11
Not administered	7
Unknown	2

vomiting. A roentgenogram of the chest made 3 days following delivery showed the presence of mottled and conglomerate shadows of increased density involving the lower two-thirds of the right lung field and the left hilum area interpreted as bronchopneumonia. Despite the extent of the infiltration as observed roentgenologically the patient did not appear ill and her temperature did not exceed 38.2 degrees Centigrade. An x ray film of the chest made 4 days later showed the bronchopneumonia to have undergone complete resolution. She was discharged in good condition on April 4, 1941.

CASE 4 E S a colored woman 19 years of age was admitted to the delivery room on February 12, 1945. Delivery was effected under ether anesthesia preceded by atropine. The patient vomited shortly following delivery. Twelve hours later she developed



Fig. 4. Case 5. Dense infiltration situated in the right upper lobe.

a shaking chill and her temperature rose to 38.8 degrees Centigrade. A roentgenogram of the chest made on the day of delivery showed mottled shadows of increased density in the lower and medial portion of the right lung field and in the left hilum area interpreted as bronchopneumonia. Sulfadiazine therapy was begun. The patient remained febrile for only 1 day and recovered uneventfully. Another roentgenogram of the chest made 6 days following admission showed the pulmonary infiltration to have undergone complete resolution. She was discharged 8 days following admission.

CASE 5 B J a white woman 19 years of age was admitted to the obstetrical service on November 9, 1943. She was delivered under ether anesthesia preceded by morphine and scopolamine medication following a labor of 15 hours duration. After delivery she developed fever rising to a maximum of 38.4 degrees Centigrade. A roentgenogram of the chest made 1 day following delivery showed a dense mottled infiltration in the upper lobe of the right lung interpreted as pulmonary tuberculosis. Although she did not present clinical evidence of serious illness she was treated with sulfathiazole for a period of 3 days. A second chest roentgenogram made 9 days following delivery showed the infiltration to have undergone complete resolution indicating that the original diagnosis of pulmonary tuberculosis was erroneous. She was discharged in good condition on November 21, 1943.

EVALUATION OF STUDY

Information concerning the 20 cases comprising this series is included in the accompanying tabular summary.

of the vessel markings has been found suggestive of pulmonary hyperemia. None of the patients have shown mediastinal displacement or other evidence of massive atelectasis.

Clearing of the infiltration was rapid in most cases and complete in all. Fifteen of 18 cases in which serial films are available showed complete clearing in 1 week or less. The time of clearing in the other 3 cases is not known with certainty but complete disappearance of the infiltration was demonstrated on the eighth, ninth, and twenty first days, respectively.

On strictly objective criteria, a roentgenologic diagnosis of aspiration pneumonia is not possible, but its recognition is usually easy if the roentgenologist has the clinical findings available to him, and if he is familiar with the condition. It may be confused chiefly with pulmonary tuberculosis, sarcoidosis, atelectasis, pulmonary edema, and other pneumonias. It is differentiated from both pulmonary tuberculosis and sarcoidosis by its rapidity of clearing as seen on serial films. It differs from lobar or massive atelectasis in its patchy character and in the absence of mediastinal displacement. Dependence must be placed upon the clinical findings to differentiate it from bronchopneumonias and pulmonary edemas of other etiology.

It is evident that a roentgenogram of the chest made shortly following delivery may be a confusing diagnostic measure if its purpose is the detection of early pulmonary tuberculosis. Chest roentgenograms made for this purpose should be taken either prior to delivery or 2 weeks or more following delivery.

CLINICAL ASPECTS

The immediate sequel to vomiting during anesthesia has been respiratory distress. In 1 of the cases, this distress was sufficiently serious to require bronchoscopic aspiration for relief. In the remainder more simple measures proved adequate. There were no fatalities in this series, although the possibility of an immediately fatal issue is indicated by the reports of Hall and of McEurlin.

The height of the fever manifested in these cases is indicated in the accompanying tabular summary. It was unusual for fever to be sus-

tained at a high level most of the patients presented one or several spikes of fever with prompt fall either to normal or to a level below 38 degrees Centigrade. None presented the appearance of septic illness, and in none were clear-cut localized physical signs of consolidation, other than rales, discovered. A slight leucocytosis, averaging 10,000 to 12,000 white cells per cubic millimeter was present in some.

PATHOGENESIS

Two chief questions arise concerning the origin and nature of these bronchopneumonias, namely what is the nature of the pathologic change in the lungs, and what is the explanation for the benign clinical course observed in these patients?

It is generally recognized that, in addition to the classical forms of massive atelectasis, smaller areas of lobular or patchy atelectasis may occur as the result of occlusion of finer bronchiolar radicles. It is probable that the shadows seen in the roentgenogram are in part due to such patches. Another factor contributing to the pulmonary changes is the reaction of the lung tissues to the irritant gastric contents, namely hyperemia, hemorrhage, edema, and exudation. Finally areas of bacterial pneumonia may occasionally supervene in areas in which virulent organisms have been implanted.

The failure of the cough reflex to expel the foreign material from the bronchial tree is probably in part due to the massiveness of the aspiration, and in part to the fluidity of the aspirated material. Archibald and Brown have shown that cough, instead of expelling material from the bronchial tree, may actually cause it to be driven deeper into its ramifications. In their experiments upon animals, iodized oil was disseminated in the bronchial tree by cough, while thick tenacious sputum, being a heavier substance, was expelled. The dissemination of iodized oil by cough is a matter of common observation in bronchography. On the basis of the experiments of Archibald and Brown, it is probable that gastric contents, because of their fluid nature and slight viscosity are widely disseminated in the bronchial tree by cough, and inefficiently and incompletely expelled.

The benign course of these bronchopneumonias has been noteworthy. One factor responsible is their incidence in a group of young healthy women without evidence of cardiac or pulmonary disease. A more important factor is the probable presence in these patients because of their age of an adequate gastric acidity, inhibiting the growth of pathogenic bacteria.

Other than coincidence (suggested by the reported deaths in other series) the only factors known to have prevented immediate death from asphyxiation have been postural drainage of the bronchial tree, and its aspiration by catheter suction in 1 instance bronchoscopically for relief of respiratory distress.

FACTORS PECULIAR TO OBSTETRICAL ANESTHESIA

A number of factors may play a part in the frequency of aspiration pneumonia in obstetrical cases. First is the frequent necessity for administering an anesthetic when the patient's stomach is laden with food. Second is the possible effect of premedication by barbiturate or by morphine in depressing protective reflexes or inducing vomiting. Third the depth of anesthesia demanded in good obstetrics is dangerously near the level at which vomiting may readily occur even when expertly administered. Daily observation suggests that the time of gastric evacuation is prolonged in labor and Meurlin states that 'a delayed emptying time of the stomach during labor is a factor which should be kept in mind.' Finally vomiting is occasionally seen in the latter part of the first stage of labor and during the portion of the second stage of labor preceding anesthesia. This may occur independently of medication and is probably of reflex origin.

PREVENTION AND TREATMENT

The well known measures of postural drainage of the bronchial tree and its aspiration by catheter suction or bronchoscopically are the recognized methods of treating vomiting and aspiration during anesthesia.

The aspiration pneumonias in this series have not been of sufficient clinical severity to require the use of chemotherapy nor did

chemotherapy affect the course of those patients in which it was used.

The administration of an emetic in early labor to the woman who has recently eaten solid food has been practiced in this community. Gastric evacuation by induced emesis, when carefully executed, might prevent the postanesthesia vomiting and aspiration of particulate matter.

The properly trained anesthetist will be able in most instances to maintain his patient in the narrow zone of anesthesia in which the labor processes are allowed to continue without the development of vomiting.

SUMMARY AND CONCLUSIONS

1 A series of 20 cases of bronchopneumonia was observed at Cleveland City Hospital which developed following obstetrical delivery in which ether inhalation anesthesia was used.

2 Their chief cause was the aspiration of gastric contents as a result of vomiting. The possible contributory rôle of the following factors was discussed: (1) preanesthetic medication favoring suppression of the cough reflex, (2) prolonged gastric evacuation in labor, (3) fluidity of gastric contents favoring their dissemination in the bronchial tree.

3 The bronchopneumonias varied in extent from small isolated patches to extensive bilateral infiltrations. They were observed in all portions of the lung fields.

4 Clinically they did not prove a cause of serious illness and no fatalities resulted. Chemotherapy by sulfonamide drugs was apparently not effective.

5 Roentgenologically the problem was one of differential diagnosis, requiring differentiation from pulmonary tuberculosis, sarcoidosis, other pneumonias, pulmonary edema and atelectasis.

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THE RETROGRADE LYMPHATIC SPREAD OF CARCINOMA OF THE "RECTOSIGMOID REGION"

Its Influence on Surgical Procedures

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FEW organs of the body have been subjected to more intensive and exhaustive study in recent years than has the rectum. This is particularly true with reference to carcinoma and its potentialities in this region. Needless to say we are still far removed from an understanding either of its cause or of its specific cure although admittedly great strides have been made especially with regard to its surgical treatment. Those advances that have been made are based on a more thorough understanding of the nature of cancer of the rectum including the form which it is likely to assume its rapidity of growth, its mode of spread and its final outcome. Here as elsewhere it has been learned that malignant disease with perhaps some few exceptions, can be adequately controlled only by complete extirpation hence the innumerable surgical methods and modifications that have come into practice.

Moynihan in 1908 made the significant statement that the surgery of malignant disease is not the surgery of organs it is the anatomy of the lymphatic system. Nowhere is this more applicable than to malignant disease of the rectum. It is toward the anatomy of the lymphatic system that the greater portion of this study has been directed. Many investigators in the past and present have devoted much of their time to its study and the results of their work as well as the conclusions of this research will be correlated in an attempt to determine what an adequate method of treatment for carcinoma of the rectum and particularly of the rectosigmoid region implies.

If as has been the dream of surgeons for many years, cancer of the rectosigmoid and upper part of the rectum with its involved diseased region can be removed, with restoration of normal continuity to the bowel and preservation of sphincteric control, a great contribution will have been made. It was with such an aim in view that this study was undertaken for should it be feasible from a pathologic standpoint an impetus for refinements in surgical attack and technique will surely follow. As carcinoma of the rectum represents some 4 per cent of all cancers (1-15) it is evident that the number of patients who might be concerned is considerable and any pathologically sound attempt to avoid the construction of an artificial anus will be well repaid. Such attempts have been numerous and with good result when properly carried out but have been frowned on by many who believe them to be more sensational than radical, basing their belief primarily on the work of Miles.

SPREAD OF CARCINOMA

Malignant disease may spread primarily in one of three ways by local extension from its site of origin by invasion of venous channels and through the lymphatic system. An evaluation of any therapeutic approach to carcinoma in a given region must therefore take into its scope each of these avenues. Although an extensive literature concerning the first two of these modes of spread exists, the original work of this paper deals only with certain aspects of lymphatic spread and consequently discussion other than of the lymphatics must necessarily be limited to a few short statements.

Local extension. Carcinomas of the rectosigmoid are relatively slow-growing malignant lesions. Microscopically three quarters of

From the Mayo Foundation and the Division of Surgery Mayo Clinic.

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them are of low grade, so that one would expect considerable local growth before any widespread metastasis has occurred. W J Mayo (25) emphasized this point in 1910 and reiterated it repeatedly (26 27) as have other writers (4 33). Indeed, in his experience local extension more than any other factor, including lymphatic and hepatic involvement, was the common cause of inoperability. That distant metastasis may occur while the mass of the disease remains localized is of course well recognized and indisputable but by and large it may be stated that a considerable period elapses in most cases before this occurs. It is obvious therefore, that all locally involved tissues must be removed at the time of operation and to accomplish this end it is absolutely essential that wide excision through healthy tissues be practiced.

Venous spread Once carcinoma has spread into venous channels with the formation of malignant thrombi and dispersion of malignant emboli, no surgical procedure however radical can be devised to rid the patient of his affliction. Were such a sequence of events customary the prognosis for cancer of the rectum would indeed be grave. Fortunately this does not obtain although investigations within the last decade tend to show that it is a more frequent occurrence than was formerly suspected.

Intravascular invasion seems remarkably constant, occurring in approximately a fifth of all cases of malignant lesion of the lower part of the colon (8 13 34). As would be expected, the higher the grade of malignancy the higher becomes the incidence of venous involvement and the greater the probability of visceral metastasis (3).

Perhaps the most significant observation concerning venous spread was made by Clogg in 1904. He noted that when dissemination via the blood stream occurred it frequently did so before the disease had spread to lymph nodes. Recent studies (13) have confirmed this impression and enlarged on it to show that most vascular invasion originates within the involved intestinal wall itself or within the immediately adjacent perirectal tissues and not from more distant extensions. Consequently although sharply limited and seem-

ingly favorable for surgical removal, a rather innocuous-appearing cancer may prove as deadly as the most widespread and perforating types. Such cases explain why the rate of cure declines in direct proportion to the degree of penetration even though no involvement of perirectal fat or lymphatic network be found. It must be obvious therefore that the threat of venous spread demands early rather than radical surgical intervention the latter being directed more especially against local and lymphatic expansion.

Lymphatic spread As carcinoma spreads through the ramifications of the lymphatics in a most systematic and relentless manner, the problem of its control must be met with equal thoroughness and determination. To do so entails an intimate knowledge of all pathways over which such an advance may occur. The literature contains several detailed and exact studies (9 32 35) to which reference may be made with considerable profit and from them Figure 1 has been constructed.

Anatomic review Considering the anus and rectum as one continuous tube it may be divided into three regions corresponding roughly to the areas supplied by the inferior, middle and superior hemorrhoidal arteries. The inferior region is the 2.5 centimeters of anus proper terminating superiorly at the pectinate line. The middle region extends upward from the pectinate line to a point just above the insertions of the levator ani muscle. The superior region extends from this point to the sigmoid colon and terminates approximately at the level of the third sacral vertebra. This latter is the largest of the three regions.

The lymphatics in all of these regions originate in a rich network of tiny lymph spaces the extremely close meshes of which extend throughout the mucosal, submucosal and intermuscular layers. Although continuous diversified connections of this network have been said to exist between all three regions for the most part they may be found to unite into their own collecting trunks, which further join to terminate in lymph nodes after the full thickness of the intestinal wall has been traversed. Thus the direction of flow is essentially at right angles to the long axis of the bowel,

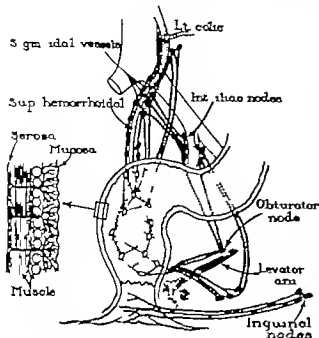


Fig. The extramural and intramural lymphatic systems of the rectum (intramural system after Letch)

even though many small intermediary branches may course in any direction en route to their final destination. In other words lymph potentially able to spread from anus to sigmoid in whole or part via these small channels never does so a point which will be discussed in some detail presently under intramural spread. Having thus arrived in the collecting trunks drainage proceeds according to definite pattern.

1 Inferior and middle regions. Although drainage from the inferior and middle regions is not strictly a concern of this work, it may be pointed out in passing that most if not all of the lymph originating in the region at the same level as, or immediately above, the insertions of the levator ani flows upward, joining the pathways of the superior region. Some may however spread laterally along the levator muscles, either superior or inferior to them and some may also spread caudally through the adipose tissue of the ischioanal fossa. Thus the lymphatic pattern of the middle region might possibly in certain instances be designated as being 'perineopelviabdominal' (Fig 1)

2 Superior region. Numerous efferent trunks pass through the muscular coat at

different levels. Most frequently these trunks become satellites of the branches of the superior hemorrhoidal vessels, usually two for each artery. After perforating the rectum they run obliquely upward and backward to reach the nodes in the mesorectum. In their perirectal course they traverse several small nodes placed on the muscular layer and covered by the serosa coat of the rectum (pararectal nodes of Gerota). These nodes are found especially in the region of the ampulla, the lowest immediately above the levator ani. The superior nodes however may be found projecting underneath the serous coat and are minute. The true mesorectal nodes of considerable size are usually grouped around the superior hemorrhoidal artery and may be regarded as the true regional nodes of the superior region of the rectum. The flow of lymph in these channels is upward, although it is conceivable that a dam or block to the natural upward course might cause lymph to flow in a retrograde manner. Normally however the lymphatic drainage of the superior region of the rectum is only abdominal in direction (35) a point which cannot be too strongly emphasized. Whereas drainage from the inferior and middle regions of the rectum may be perineopelviabdominal with anastomoses in the posterior part of the vagina and the levator ani muscles, drainage from the upper part of the rectum has no direct anastomoses with pelvic organs unless it be by long tedious and unnatural retrograde flow down the surface of the rectum in the face of complete upward blockage as suggested previously.

Pathologic consideration. Having thus become well versed in the normal course of lymphatic drainage in and from the rectum it is now possible to appreciate more fully how malignant processes avail themselves of these channels. Discussion will be greatly facilitated by dividing the lymphatic system as a whole into intramural (from mucosa to serosa) and extramural (from serosa to regional nodes) components.

1 Intramural (Fig 1) Carcinoma of the rectum takes its origin from altered mucosal cells of the rectal lining usually stated as arising deep in the crypts of Lieberkühn. From this tiny focus it may spread either by direct

extension and invasion of small lymph meshes from its margins or directly through the thickness of the rectal wall. Marginal extension is greater and more rapid transversely around the bowel than through the rectal wall but even transverse extension is extremely slow. 6 months being the estimated time for carcinoma to travel approximately a quarter of the way around the lumen. Advance through the submucosal and muscular layers is equally slow and the serosal covering has usually not been reached until the growth has traversed three quarters of the circumference of the bowel or until some 18 months have elapsed. The circular and longitudinal muscles are pierced by radial channels thus giving free communication for malignant cells to travel between submucosal intermuscular and subserosal plexuses.

Cole was able to show that whereas carcinoma spread more widely in the submucosa than on the mucosal surface and still more widely in the muscularis there was no evidence of longitudinal permeation of the intestinal wall beyond the microscopic edge of the growth. Other studies appearing at approximately the same time all substantiated this view (5 22 30). Monsarrat and Williams demonstrated that as a rule longitudinal spread occurs only to the distance of about 2 centimeters above or below the gross mucosal edge of the lesion and that this invasion is greatest in the subserosal portion. In more recent years ample evidence (12 20 21 24 29) has accumulated indicating the improbability of any widespread dissemination along the course of intestinal walls comparable to the spread along the wall of the stomach that may occur in cases of gastric carcinoma. Apparently described anastomotic channels to any great distance are potential rather than actual. Leitch has expressed the belief that the lymphatics of the mucosa do not exist as a continuous plexus but are arranged in a decussating arborescent pattern from the collecting stems which pierce the circular muscular coat. Spread in the intermuscular lymphatics is just as limited (Fig 1). It may therefore be stated that intramural dispersion aligns itself closely with observed gross and microscopic extensions of the growth and plays no

part in the demand for extensive radical surgical intervention

2 Extramural. By far the most important mode of extension extramural spread has accordingly been the subject of most well directed research to date. Because of its supposedly widespread potentialities carcinoma at the rectosigmoid juncture has for the most part been subjected to the same treatment as has carcinoma lower in the rectum with removal of perianal skin rectal sphincter and the whole pelvic colon. Evidence in the literature combined with that of this study will demonstrate rather conclusively however that many growths high in the rectum lend themselves admirably to procedures far less radical than this and more acceptable to the patient but equally effective as far as the disease process is concerned. Close scrutiny and attention to detail will reveal a loophole which up to the present although noted by several investigators has failed to become widely recognized as such. True it is that a few surgeons have explored these possibilities to their own satisfaction but the majority either are unaware of the opportunities afforded or have been misled by existing pathologic studies.

In accord with anatomic findings Miles observed that malignant processes might extend in an upward lateral or downward direction although in his study he made no attempt to give the exact location of the lesions employing these various pathways. The common course is upward for it occurs in every case regardless of the site of the lesion from anus to sigmoid.

Lateral dissemination refers to that which courses along the levator ani muscles, the coccygeal base of bladder cervix or base of the broad ligaments to terminate in the internal iliac nodes. Miles has encountered such involvement in several cases both in that portion of the levators immediately adjacent to the bowel and far laterally near the pelvic walls. Gilchrist and David made similar observations in 4 cases of their series. Collier, Kay and MacIntyre in 6 and Gordon Watson and Dukes (18) in 1 case. That lateral dissemination may occur therefore is unquestioned and when one is dealing with low lying growths it must be given due consideration.

TABLE L—INCIDENCE OF RETROGRADE NODAL METASTASIS IN CARCINOMA OF RECTUM AND RECTOSIGMOID REVIEW OF LITERATURE

	Total cases	Positive nodes—cases	Nodes involved below lesions—cases	Distance below lesions—cm	Site of nodes
McVay 1929	100	47		0—	Aspirin
Wood and Wilkie, 1935	100	5		—	—
Wentham, 1934	74	7			?
Gabriel, Dukes and Bussey 1935	200	6		0—1	Upper rectum (4 and 9 cm) *
Güchert and David, 1938	5	4		and	Aspirin
Callier Kay and MacIntyre, 1940	22	22		5	Rectosigmoid
Grinnell, 1942	75	41			Aspirin (4 cm) *
Total of cases in the literature	507	101	5		
Glover and Waugh, 1944			17	0—	Upper rectum, rectosigmoid and lower sigmoid
			6	2—4	
				2—3	
				3—4	
				6—7	
Total of Glover and Waugh's data	100	66	38		

*Above the pectinate line

Downward invasion, as Miles used the term refers to spread along the inferior hemorrhoidal vessels through ischioanal fat and Alcock's canal, eventually to internal iliac nodes. Miles discussed 1 specimen removed by abdominoperineal resection in which the cancerous process had taken such a course. Other evidence that he presented was derived from records of postoperative recurrent growths occurring in the posterior wound. Whether these growths may be regarded as of true lymphatic origin or as occurring by direct invasion is a matter for debate. Gordon Watson and Dukes were undecided as spread in 2 of the 3 cases in which they noted ischioanal involvement appeared more likely to be by direct continuity.

The long unbroken chain of lymph nodes originating in the small pararectal nodes of Gerota deeply placed in the pelvis posterior to the rectum and extending through the larger superior hemorrhoidal group on into paraortic channels constitutes the upward and primary lymphatic drainage of the rectum. Neoplastic lesions situated anywhere within the pelvic colon sooner or later advance over this well traveled route. In the upper part of the rectum it is the *only lymphatic avenue available* for malignant invasion

unless, on further investigation, ideas concerning the importance of recently described perineural or perivascular (34) networks are confirmed.

This upward spread proceeds in an orderly manner so that on specimens from cases of advanced carcinoma there is a sequence of involved nodes stretching from the primary growth to the point of ligature of the inferior mesenteric vessels. This procession is usually from node to node but occasionally it is discontinuous with considerable intervening gaps, due to the presence of several upward tracks running so to speak over the same roadbed. Numerous paths course directly to nodes at the bifurcation of the superior hemorrhoidal vessels, a few to the junction of the superior hemorrhoidal and lowest sigmoidal vessels, by passing all nodes en route and others to the junction of the left colic and inferior mesenteric vessels. Thus on occasion, intervening uninvolved nodes have been observed, so that it is impossible to state which node is the highest seat of metastasis unless all to a considerable height have been examined. Examples of this pattern have been shown by Grinnell, Gabriel, Dukes, and Bussey (14), Wood and Wilkie as well as many others.

As no anastomoses of the lymphatics of the upper part of the rectum with those of pelvic organs exist, no lateral spread of carcinoma of the upper part of the rectum as described previously can occur via the lymphatics. Invasion by direct continuity may and does of course take place in direct proportion to the age of the growth.

Downward or retrograde spread along the course of the bowel through pararectal nodes although normally nonexistent may under certain circumstances be observed. In cases of advanced carcinoma in all probability beyond the realm of surgical cure when the superior hemorrhoidal and inferior mesenteric nodes all or in great proportion become clogged with extensive metastasis cancerous cells may take the course of least resistance downward in this instance over the same pathways which normally carry only one-way traffic—upward (17). Examples of this in the literature are rare and may be seen in Table I. There it will be noted that only 8 such cases have been observed the node at 4 centimeters below the lesion (Gilchrist and David) probably being the only true demonstration of such retrograde flow. If therefore retrograde metastasis is so rare and there are no other lymphatic anastomoses between the upper part of the rectum and pelvic structures should it not be reasonable that such facts be more widely applied in the surgical attack on lesions of the upper part of the rectum and rectosigmoid region? In order to be certain that such a stand could be taken on factual pathologic evidence and in the feeling that examination of the portion of the rectum and perrectal tissues lying between the lower part of the sigmoid and the insertion of the levator ani muscles would give the crucial answer long and tedious study was directed at this region by means of the following procedures.

MATERIALS AND METHODS

One hundred surgically removed rectums containing adenocarcinoma of the upper part of the rectum the rectosigmoid or the lower part of the sigmoid were obtained from the Division of Surgical Pathology of the Mayo Clinic. An attempt was made to secure only those specimens which represented far ad-

TABLE II—RETROGRADE LYMPHATIC SPREAD IN 100 CASES OF CARCINOMA OF THE RECTOSIGMOID BY GRADES (BRODERS)

Macroscopic grade	Total cases	Nodal involvement below lesion—cm			
		0-	1-3	3-4	6-7
	3	0	—	—	—
	48	1	—	—	—
3	7	6	—	—	—
		4	—	—	—
Total	100	7	6		

*See report of Case 7

vanced disease so that the greatest possible spread of neoplastic cells might be contained therein. A choice from 2,206 such specimens was made only those removed by combined abdominoperineal technique being used to be assured of the maximum tissue for dissection.

That these specimens constituted a group containing most extensive malignant lesions is evidenced in several ways. All of the adenocarcinomas were of Duke's type C (11) that is all had metastasized to adjacent and regional lymph nodes. Grossly 99 were ulcerative and 1 was polypoid. Ulcerative lesions of the colon are the most malignant and invasive type. Twenty nine had advanced to perforation. Eighty three of the ulcerative lesions were annular. As to their site of origin in the upper part of the rectum and above 9.5 centimeters was the average distance from the lower gross mucosal edge of the lesion to the anorectal or pectinate line. This fact was ascertained by measurements of the formalinized specimens as well as by those recorded on the pathologist's report made at the time of operation and further corroborated by proctoscopic examination before operation.

It was originally intended to select the cases in equal number from each of the four grades of malignancy as classified by Broders thus making comparison of results more uniform than it would be otherwise. However as 75 per cent of rectal lesions are of low grade (1 and 2) it was impossible to secure enough specimens of the higher grades (3 and 4) which had not previously been used for other studies to fill in the required quota. Rather than sacrifice accuracy for statistics, all those lesions of higher grade which fulfilled the pre-

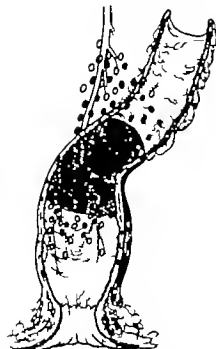


FIG. Case Location of the carcinoma with reference to the bowel, lymphatic and vascular systems (carcinoma, shaded area; involved nodes, black dots; uninvolved nodes, open dots)

viously stated requirements were chosen first—27 in number—and the difference up to 100—73 cases—was obtained from the more plentiful carcinomas of low grade (Table II).

Two methods for the complete examination of the lymphatic region of an organ are available. The injection method, the one most recently used and especially adapted to the examination of fresh tissues, is that described by Spalteholz and modified by Gilchrist and David. This type of investigation is accurate and has enabled its advocates to find many more nodes than they were previously able to locate by gross dissection of fresh specimens.

The other method is the more time-consuming and laborious gross dissection. This is the only method which can be used for tissues long immersed in formalin and may with application produce as satisfactory results as the injection method. Suffice it to say that the dissection method yielded results quite comparable to any other for in those 5 cases of this series in which all the nodes on the entire specimen were examined an average of 60 nodes per specimen was found, the largest number being 82, the smallest 44.

By gross dissection then each of the 100 specimens was minutely examined from the lower gross mucosal edge of the lesions present to the anus. Serial sections were cut each approximately 1 centimeter in width, the incisions beginning in the perirectal fat and being carried into the mucosa. The numerous slices thus produced were allowed to remain hinged on the mucosa so that accurate measurements could be taken concurrently. All lymph nodes were removed and each was carefully labeled not only as to its relationship to the lesion itself but also as to its position on the vascular tree. From these data all nodes were charted on diagrammatic sketches of the pelvic colon which were drawn to scale and on which each lesion had previously been outlined also according to scale. An average of 11 nodes per specimen was found between the limits outlined previously, the largest number being 53, the smallest 2. A total of 1,339 nodes was found during the course of the whole study including nodes examined behind and above the lesions in the few cases indicated later.

Each node was then subjected to microscopic examination by the frozen section technique used in this case for screening those nodes metastatically involved from those uninvolved. All nodes containing any evidence of cancerous cells were further sectioned and stained with hematoxylin and eosin for study. Those found to be free from involvement were not examined further. One thousand four hundred seventy nine sections were made.

RESULTS OF STUDY

In 64 cases there was no spread distal to the lower gross mucosal level of the lesion but in 36 cases there was distal spread. In 27 of the 36 cases the nodal involvement was within the first centimeter and no lower; in 6 it was between 1 and 2 centimeters but no lower; and in 1 case each it was between 2 and 3 centimeters, 3 and 4 centimeters, and 6 and 7 centimeters.

All those cases in which there were positive nodes from the lesion to 2 centimeters but no lower were considered to be of no particular significance for the reason given previously in the section on intramural spread. It will be

remembered that as malignant invasion proceeds from the mucosal to the serosal surface of the intestinal wall it does so in a more or less triangular fashion the base of the triangle being placed longitudinally along the long axis of the bowel in the perirectal fat at the serosa. In advanced lesions such as these the greater involvement in the perirectal fat and serosa as compared with involved mucosa always extended 1 centimeter below and above the longitudinal diameter of the lesion as measured on the mucosa frequently extended to 2 centimeters in either direction and was occasionally seen at 3 centimeters. As a consequence all nodes within the first centimeter were found to be imbedded in carcinomatous tissue so that their removal for microscopic examination was in reality of academic interest only. Four of the 6 cases in which lymphatic spread was 1 to 2 centimeters were in this same category. In the other 2 cases the involved nodes were immediately adjacent to but not actually imbedded in carcinomatous tissue. The nodes from the 3 cases in which nodal involvement was more distal however were further removed from directly involved tissues although malignant extensions from the local growth were considerably closer than the indicated distance as measured from the lower mucosal level of the lesion. In summary therefore of the 100 cases in which the tissues were thoroughly examined only 3 could be classified as exemplifying true retrograde metastasis of any significance.

The obvious question now arises. Why did retrograde lymphatic permeation occur in 3 cases and not in the others? This problem entailed the re-examination of those tissues in which retrograde spread had occurred. For the sake of obtaining more complete evidence and also because 2 of the 6 cases with spread to 2 centimeters might be construed as instances of downward spread all cases in which the distance was more than 1 centimeter were included in this additional study. In the same manner as has already been described all remaining nodes on the 9 specimens in question except as indicated were removed and subjected to sectioning and charting. A detailed report was prepared for each case consisting of both clinical and

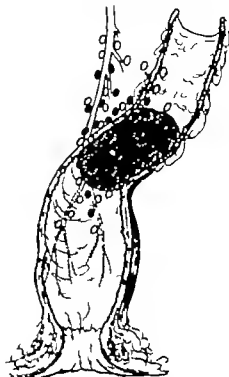


Fig. 3. Case 2. For explanation see legend of Figure 2.

pathologic features as they applied in each instance.

REPORT OF CASES

CASE 1. A white woman, 61 years of age, registered at the Mayo Clinic July 14, 1917, with a chief complaint of rectal stoppage. A detailed history revealed 1 year of rectal bleeding, suprapubic uneasiness, ribbon like stools and finally almost complete obstruction and loss of 20 pounds (9.1 kgm.). Physical examination gave negative results except for a large, hard, fixed encircling mass high in the rectum. On July 23, 1917, one stage perineoabdominal resection was performed. During the operation a small suspicious nodule was felt in the liver. The patient was dismissed from the clinic on August 31, 1917, after an uncomplicated recovery. The last report indicated her death in November, 1917. No details were given. Grossly the surgical specimen contained a very extensive annular ulcerative lesion 7 by 6 by 4 centimeters; mucosal measurement 6 centimeters above the pectinate line. A total of 70 lymph nodes were found. Microscopically the lesion was an adenocarcinoma, grade 4 (Broders). For distribution and involvement of nodes see Figure 2. The lowest involved node was found between 1 and 2 centimeters below the lower mucosal edge of the lesion.

CASE 2. A white man, 36 years of age, registered at the clinic April 25, 1934, with a chief complaint of constipation after 6 months of blood-streaked, mucoid rectal discharges, dull abdominal aches and pains, increasing constipation and loss of 7 pounds (3.2 kgm.). Physical examination gave essentially



Fig. 4. Case 3. A cross section through the perirectal tissues at about the midportion of the lesion as illustrated in Figure 5. The solid carcinomatous area on the left corresponds to the double crosshatched area in Figure 5. The two nodes to the right above are also represented in Figure 5. They were found to be completely replaced with cancer cells. The block to the upward flow of lymph is obvious.

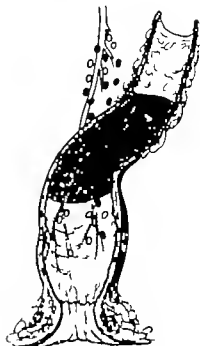


Fig. 5. Case 3. For explanation see legend of Figure 4. Compare with Figure 4.

negative results except for a large encircling lesion especially prominent on the posterior wall high in the rectum. This lesion was verified by proctoscopic examination. On May 1, 1934, one stage combined abdominoperineal resection was performed. At operation the liver was noted as clear. The patient was dismissed from the clinic on May 24, 1934, after an uncomplicated recovery. The last report indicated death in December, 1935, with extensive metastasis about the colonic stoma, abdomen and liver. Grossly the surgical specimen contained a huge ulcerative lesion 15 centimeters in diameter, mucosal measurement 10 centimeters above the pectinate line. A total of 55 nodes were found. Microscopically the lesion was a colloid adenocarcinoma, grade 4 (Broders). For distribution and involvement of nodes see Figure 3. The lowest involved node was found between 1 and 2 centimeters below the lower mucosal edge of the lesion.

CASE 3. A white man, 50 years of age, registered at the clinic July 22, 1936, with a chief complaint of "bloody diarrhea." For 1 year he had had bloody rectal discharge and dull abdominal cramps with a final weeks of constant pain and constipation. He had lost 40 pounds (18.1 kgm.). Physical examination revealed a huge, hard, irregular cauliflower-like mass in the rectum which was verified by proctoscopic examination. On July 27 and August 24, 1936, two stage combined abdominoperineal resection was performed. The liver was clear but there was extensive spread to the bladder and around the left ureter. The patient left the clinic in September 12, 1936,

without dismissal but recovery had been uncomplicated. The last report indicated death in April, 1937, but no details were given. Grossly the surgical specimen contained an extensive annular ulcerative lesion 9 by 8 by 5 centimeters, mucosal measurement 6 centimeters above the pectinate line. Thirty-two nodes only were removed and examined; the others were allowed to remain *in situ* for photographic evidence as shown in Figure 4. Microscopically the lesion was an adenocarcinoma, grade 2. For distribution and involvement of nodes see Figure 5. The lowest involved node was found between 2 and 3 centimeters below the lower mucosal edge of the lesion.

CASE 4. A white woman, 3 years of age, registered at the clinic August 22, 1938, with a chief complaint of "diarrhea." For 3 months she had had colicky pains in the left lower quadrant associated with diarrhea, occasionally bloody. She had lost 13 pounds (5.9 kgm.). Physical examination gave negative results except for a mass with some fixation of the bowel on rectal examination. Proctoscopically a lesion was found involving the right and anterior walls of the lower part of the sigmoid colon. On August 29 and October 3, 1938, two stage combined abdominoperineal resection was performed. The liver was noted as clear but there were implants throughout the pelvic peritoneum. The patient was dismissed from the clinic November 19, 1938, in good condition after a mild postoperative urinary infection. The last report indicated death on April 7, 1941, from a recurrence. Grossly the surgical

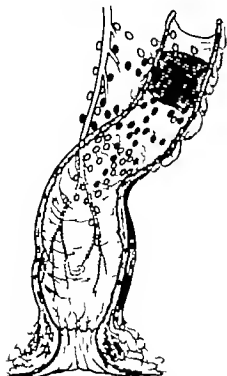


Fig. 6 Case 4. For explanation see legend of Figure 2

specimen contained a perforated annular ulcerative lesion 4 by 3 by 3 centimeters mucosal measurement 16 centimeters above the pectinate line. A total of 84 nodes were found. Microscopically the lesion was an adenocarcinoma grade 3 (Broders). For distribution and involvement of nodes see Figure 6. The lowest involved node was found between 6 and 7 centimeters below the lower mucosal edge of the lesion.

The question arises in this particular case whether all the involved nodes shown below the lesion in Figure 6 represent true *retrograde* spread. As the lesion itself was in the lower part of the sigmoid, a portion of the colon still maintaining a mesentery, it seems probable that normal flow of lymph had occurred over the two lower rectosigmoid arcades, both of which lie below the lesion. This is consistent with the lymphatic drainage of the colon proper which differs from rectal drainage in that it may proceed along the axis of the bowel in either direction from a lesion until a vascular arcade has been reached at which point it courses in through the mesentery to large midline plexuses of nodes. In that event only the four lower carcinomatous nodes, a span of about 3 centimeters, would represent true *retrograde* involvement. However, as

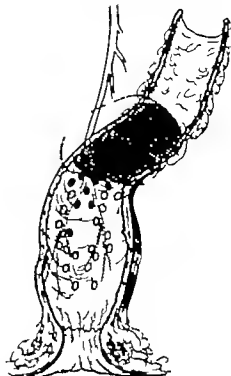


Fig. 7 Case 5. For explanation see legend of Figure 2. Compare with Figure 8.

the original premise and conditions of study included all nodes below the level of the lesion, all the nodes in Figure 6 will be considered as examples of *retrograde* spread.

CASE 5. A white woman, 57 years of age, registered at the clinic November 13, 1939, with a chief complaint of increasing constipation of 8 months duration, bloody stools and the continual sensation of a full rectum. She had lost 17 pounds (7.7 kgm.). Physical examination gave negative results except for a large rectal mass which was confirmed by proctoscopic examination. On November 17, 1939 and January 19, 1940, two stage combined abdomin-



Fig. 8. Case 5. Lesion from serosal surface. Because of the absolutely solid nature of the infiltrating carcinoma in the perirectal fat it was deemed unnecessary to attempt dissection of the nodes behind and above the lesion in this case.

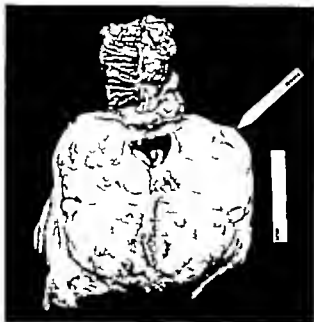


Fig 9. Case 6. Lesion from serosal surface split and laid open, showing the solid nature of the infiltrating cancer (see report of Case 6)

operineal resection was performed. The liver was noted as clear. The patient was dismissed from the clinic March 18, 1940 in good condition after a complicating postoperative thrombophlebitis. The last report indicated death on April 12, 1941 from a recurrence. Grossly the surgical specimen contained a large annular ulcerative lesion 7 by 6 by 5 centimeters mucosal measurement 9 centimeters above the pectinate line with two polyps one 5 centimeters below the growth and one 1 centimeter above it. Twenty-seven nodes only were removed and examined the others were allowed to remain *in situ* for photographic evidence as shown in Figure 8. Microscopically the lesion was a colloid adenocarcinoma, grade 2 (Broders). For distribution and involvement of nodes see Figure 7. The lowest involved node was found 3 to 4 centimeters below the lower mucosal edge of the lesion.

CASE 6. A white man, 52 years of age, registered at the clinic December 2, 1940 with a chief complaint of weight loss. For 3 months he had had rectal bleeding, urgency, and bouts of diarrhea and constipation. He had lost 17 pounds (7.7 kgm.). Physical examination revealed a "mass felt high in the rectum" which was confirmed by proctoscopic examination. On December 7, 1940 one stage combined abdominoperineal resection was performed. The liver was clear to palpation. The patient was dismissed from the clinic January 2, 1941 in good condition. The last report on June 18, 1941 stated that he suffered from backache and pain down both legs. There has been no further communication. Grossly the surgical specimen contained an ulcerative lesion 5 by 4 centimeters with direct extension

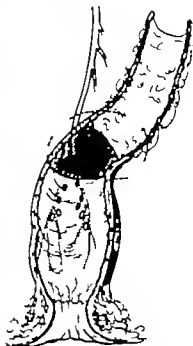


Fig. 10. Case 6. For explanation see legend of Figure 9. Compare with Figure 9.

into perirectal tissues forming a mass 8 by 6 centimeters. The lesion was 8 centimeters above the pectinate line. Only 9 nodes were removed and examined the others being allowed to remain *in situ* for photographic evidence as shown in Figure 9. Because of the absolutely solid nature of the infiltrating cancer throughout all perirectal tissues behind and above the lesion it was not considered necessary to isolate nodes in order to demonstrate their blocked nature. Figure 9 demonstrates adequately the large dam-like mass extending around the bowel and effectively shunting advancing carcinoma in a retrograde direction. Microscopically the lesion was an adenocarcinoma, grade 3 (Broders). For distribution and involvement of nodes see Figure 10. The lowest involved node was found 1 to 2 centimeters below the lower mucosal edge of the lesion.

CASE 7. A white woman, 53 years of age, registered at the clinic June 6, 1941 with a chief complaint of "bloody diarrhea" of 5 months with spells of low backache. She had not lost weight. Physical examination demonstrated a large, nodular mass on the left posterior wall of the rectum which was confirmed by proctoscopic examination. On June 10 and August 8, 1941 two stage combined abdominoperineal resection was performed. On September 15, 1941 the patient was dismissed in good condition after complicating thrombophlebitis, pulmonary embolism and pneumonia between stages of the resection. September 10, 1941 a plastic operation was performed on the colonic stoma. From September,

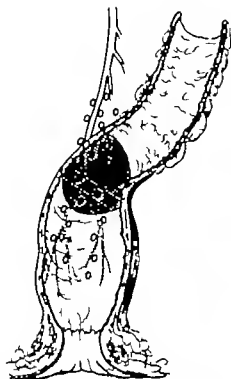


Fig. 1. Case 7. For explanation see legend of Figure 2. Compare with Figure 12. The small black rectangle is discussed in the report of Case 7.

1942 to April 1943 four courses of roentgen therapy were given. The last report on September 23, 1943, showed the presence of some pelvic pain. Grossly the surgical specimen contained an annular ulcerative perforating lesion 5 by 4 by 1.5 centimeters, mucosal measurement 8 centimeters above the pectinate line. A total of 23 nodes were found. The small black rectangle shown on Figure 11 between 1 and 2 centimeters below the growth represents tissue removed under the impression that it was a lymph node. Careful microscopic examination indicated that very little lymphoid tissue could be identified. There was however a small blood vessel with a small region of carcinomatous cells immediately adjacent, which may have represented a tiny node completely replaced by cancer or may have been a rare demonstration of perivascular spread (Fig. 12). In any event it was impossible to show adequate evidence of a block above this lesion as only 4 of the 14 nodes behind and above the lesion were involved. Microscopically the lesion was an adenocarcinoma grade 1 (Broders). For distribution and involvement of nodes see Figure 11. No involved nodes were found below the lower mucosal edge of the lesion.

CASE 8. A white man 62 years of age registered at the clinic September 8, 1941, with a chief complaint of "alternate constipation and diarrhea. One year of constipation, rectal bleeding, painful movements and a loss of 12 pounds (5.4 kgm) were the main symptoms. Physical examination disclosed a high fixed lesion in the rectum which was verified



Fig. 12. Case 7. Possible perivascular lymphatic spread as discussed in report of Case 7. The vessel is cut longitudinally the lumen appearing as a strand of cells in the upper right corner. $\times 100$.

by proctoscopic examination. On September 25 and October 27, 1941, two stage combined abdominoperineal resection was performed. The liver was clear. The patient was dismissed on December 4, 1941, in good condition despite a mild urinary infection (postoperative). The last report on July 16, 1943, indicated a loss of 15 pounds (6.8 kgm) but no other evidence of recurrence. Grossly the surgical specimen contained an annular ulcerative perforating lesion 7 by 6 centimeters, mucosal measurement 12 centimeters above the pectinate line. A total of 56 nodes were found. Microscopically the lesion was an adenocarcinoma grade 4 (Broders). For distribution and involvement of nodes see Figure 13. The lowest involved node was found between 1 and 2 centimeters below the lower mucosal edge of the lesion.

CASE 9. A white woman 39 years of age registered at the clinic September 17, 1942, with a chief complaint of constipation. For 2 years she had had recurrent rectal bleeding, pain high in the rectum and increasing constipation. She had lost 8 pounds (3.6 kgm). Physical examination revealed a palpable mass high in the rectum which was confirmed by proctoscopic examination. On September 23, 1942, one stage combined abdominoperineal resection was performed. The liver was clear. On October 16, 1942, a course of roentgen therapy was given. The patient was dismissed October 20, 1942, in good

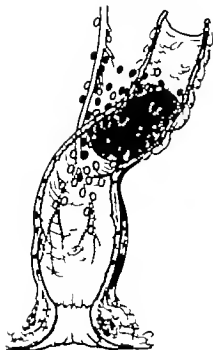


FIG. 3. Case 8. For explanation see legend of Figure 2.

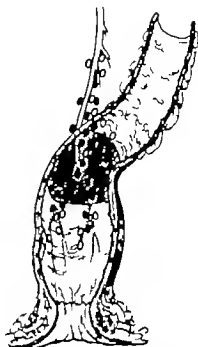


FIG. 4. Case 9. For explanation see legend of Figure 2.

condition after a mild urinary infection. The last report was on September 6, 1913, when a check up at the clinic revealed no evidence of recurrence. Grossly the surgical specimen contained an annular, ulcerative lesion 5 by 4 by 2 centimeters, mucosal measurement 7 centimeters above the pectinate line. A total of 44 nodes were found. Microscopically the lesion was an adenocarcinoma, grade 4 (Broders) with squamous-cell metaplasia. For distribution and involvement of nodes see Figure 14. The lowest involved node was found between 1 and 2 centimeters below the lower mucosal edge of the lesion.

SUMMARY OF REPORT OF CASES

Nine cases of carcinoma of the rectosigmoid demonstrating possible retrograde spread have been presented in detail with all pertinent clinical, surgical, and pathologic data. In 5 cases all the nodes on the specimens were examined microscopically and in each case approximately two thirds of the nodes found behind and above the lesion were so completely clogged with cancer cells that any further drainage of lymph through their sinuses seemed impossible (Cases 1, 2, 4, 8, 9). In 1 case only a portion of the lymph nodes were examined. More than three quarters of these nodes found behind and above the lesion were completely involved with carcinoma and photographic evidence was sufficient to show

that all other nodes were likewise involved (Case 3). In 2 cases the tissues were so extensively frozen in cancer that it was deemed unnecessary to show any further evidence of their complete involvement than that demonstrated photographically (Cases 5 and 6). Case 7 remains an enigma. Whether the retrograde spread demonstrated in this specimen represented an involved node or was a rare instance of perivascular lymphatic permeation is unanswerable. In any event there was not the high percentage of nodal involvement behind and above the lesion considered to be necessary to form a block to the upward flow of lymph.

It may thus be concluded that, when retrograde lymphatic spread down the course of the rectum and its ensheathing structures occurs, it does so as the direct result of a block occurring somewhere across its upward channels and that the contained lymph stream is merely seeking the course of least resistance, all normal upward avenues for drainage being closed.

COMMENT

For confirmation of the mass of evidence against any normal retrograde dissemination

of neoplastic cells from malignant growths in the upper part of the rectum and above presented in the preceding pages, it is interesting to refer to the pathologic data which have thus far accumulated in the literature. Table I represents a complete summary of such data.

In more than 239 of the 507 cases from the literature in which the removed tissues were completely examined nodal metastasis was observed to occur. Of these only 8 gave evidence of an involved node below the level of the lesion itself. As the lower level of the lesion was not defined in each case the actual distance of these nodes from the lesion can only be conjectured. Nevertheless, in 7 of the 8 cases there was no spread below the 2 centimeter level which when interpreted in the terms outlined in this study remains insignificant. One case therefore that of Gilchrist and David in which the involved node was 4 centimeters below the lesion represents the total significant retrograde lymphatic flow from carcinoma of the rectum contained to date in the literature. When combined with results given previously for our cases only a fraction over 1 per cent of far advanced malignant growths of the pelvic colon may be expected to metastasize in a retrograde fashion. If this obtains so rarely in cases in which the patient is already doomed to early demise one cause of the advanced nature of the lesion one may be justified in making the statement that retrograde lymphatic metastasis never occurs from growths still in the stage of reasonable operability.

Perusal of Table I will further demonstrate that about a half of all neoplastic growths of the rectum when seen at operation do not as yet have nodal involvement. To be certain that this was true over the years from which the cases in this study were drawn Table III was constructed. There it will be noted that in 59 per cent of the cases there was no nodal involvement. To be sure had all these cases shown from 1916 to 1942 inclusive been subjected to intensive study no doubt the 59 per cent would drop below 50 per cent as recent published studies in which the data were so treated indicate (8, 16). However the 1 per cent incidence of retrograde lymphatic spread in advanced cases when adjusted to include

TABLE III—NODAL INVOLVEMENT IN CARCINOMA OF THE UPPER PART OF THE RECTUM, RECTOSIGMOID AND SIGMOID CASES IN WHICH THE LESION WAS RESECTED AND GRADED (1916-1942 INCLUSIVE)

Nodes	Total		Grades and (Broders)		Grades 3 and 4 (Broders)	
	Number	Percent	Number	Percent	Number	Percent
Positive	910	4	570	37	3	63
Negative	246	50	1, 60	63	37	35
Total	8, 305	100	2, 133	100	40	100

the average type of carcinoma occurring in the rectum (approximately 50 per cent with nodes uninvolved) then drops to less than 0.5 per cent and as such becomes negligible. Should it not be possible therefore in the light of pathologic evidence and in view of the many recent advances in colonic surgery to preserve the lower part of the rectum in a very considerable number of cases in which the patients heretofore have been deprived of normal sphincteric control (10)? Perhaps time alone will provide the answer but certain it is that such attempts are more than justified and should engage the attention of all surgeons who endeavor to relieve the encumbrances of rectal neoplasms.

CONCLUSIONS

The following significant features deserve a word of emphasis in conclusion.

1. Because carcinoma of the rectum is primarily of a low grade of malignancy the disease tends to remain localized for a considerable period and thus lends itself admirably to surgical attack.

2. As carcinoma of the upper part of the rectum and the rectosigmoid has only one normal channel for lymphatic spread—upward—provided local growth by direct extension has not incorporated neighboring organs, it should be suitable for radical segmental resection with preservation of the rectal sphincter and restoration of the normal continuity of the bowel.

3. Radical segmental resection implies the removal of a wide section of bowel together with its complete node-bearing region just as the abdominal portion of a combined abdomi-

noperineal resection is now performed (technique to be reported)

4. Section of the bowel must be at least 2 centimeters below the lower palpable edge of the lesion to satisfy pathologic requirements. The technical requirements in the successful performance of an adequate anastomosis in this area also involve the removal of such an amount of tissue because of the size and position of neoplasms so located.

5. It has been demonstrated that even in far advanced cases of carcinoma in this region retrograde spread along the course of the bowel occurs to any degree in only 1 per cent.

6. When such retrograde spread can be demonstrated it is an indication that upward normal channels have been blocked.

7. When these facts become more generally appreciated and the technical procedures required for such surgery are subjected to refinement many sufferers from neoplastic lesions in the rectosigmoid region will enjoy a normal postoperative existence without the psychologic—to say nothing of the anatomic—detriments of a permanent artificial anus.

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RECTAL STRICTURES DUE TO LYMPHOGRANULOMA VENEREUM

With Especial Reference to Pauchet's Excision Operation

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DESPITE the abundant and ever increasing literature on the general subject of lymphogranuloma venereum surgeons still differ greatly in their opinions as to the best method of treatment of lymphogranulomatous strictures of the rectum. The use of sulfonamides and more recently of penicillin has lessened secondary infection in these cases, but in no way has it decreased in certain cases the tendency of the disease to progress and develop fibrous tissue that cicatrizes and produces marked rectal stenosis.

An example of such a patient is presented through the courtesy of Dr Marshall E Ross, of the gynecological service with whom one of us (L T W) examined the patient in consultation.

S D colored widow 45 years of age a domestic, was seen August 7 1937. She complained of a swelling about the vulva, which began as a small pimple 18 years before, gradually grew larger and was painful. In 1935 because of constipation and pain on defecation she was treated elsewhere with deep x ray therapy. The vulval swelling immediately increased in size she had lost weight, was easily fatigued and had pain in the perineum. The Frei test was strongly positive and a biopsy of tissue from the vulval swelling which also involved the anus showed marked fibrosis with round cell infiltration and some plasma cells. Examination on contraction in August, 1937 revealed elephantiasis of the vulva involving the anus, a stricture of the vagina, a rectovaginal fistula and a marked annular stricture of the rectum 1 centimeter above the internal sphincter. She was advised to have a colostomy operation but refused. She subsequently moved to Connecticut, and in reply to a follow-up letter her physician wrote under date of November 18 1938 as follows:

When first examined she had large sloughing pedunculated granulomatous ulcerated overgrowths

From the Surgical Service of the Harlem Hospital, Dr Louis T Wright, director.
Founders Lecture, Medicosurgical Society of the District of Columbia, November 5, 1943.

Involving the labia majora and minora extending from the pubis in front and including the rectal sphincter behind. The rectal sphincter had been entirely destroyed and the septum between the vagina and the lower rectum was destroyed. A complete excision of the growth from the pubes to the coccyx was done and the wound was closed except for drainage at the angles. For about 2 weeks she did very well and then the wound broke open somewhat leaving a granulating surface, which was skin grafted. The skin graft took for the most part. She left the hospital and was up and around feeling fairly comfortable.

But the wound gradually broke down and signs of intestinal obstruction developed. Stricture ever narrowing could be felt at the junction of the rectum and sigmoid. As it seemed evident that the infection still persisted in the lower rectum and around the stricture and in the pelvis where a large mass could be felt it was decided to do a laparotomy. At laparotomy a large dermoid growth of the right ovary the size of a grapefruit was found. This growth was removed and in addition a hysterectomy double salpingo-oophorectomy and colostomy were done bringing the sigmoid out through a stab wound in the left flank. A resection of the lower segment of the sigmoid and rectum including the stricture was also done. The patient withstood the ordeal remarkably well. She recovered and went home. Later she returned and at that time she had developed squamous cell carcinoma at the left edge of the vagina at the junction of the vaginal mucosa and skin. Radical needles were inserted in this growth and the cancer disappeared and again she returned to her home.

She returned in a few weeks with a crater about 2 inches deep burrowing into the left upper leg toward the femoral artery and the left side of the vagina was involved in this crater. Numerous sinuses discharged pus which oozed from openings throughout the floor of the crater so that as it was impossible to incise all these to give adequate drainage was removed the crater looked quite healthy and was healing satisfactorily but the patient became increasingly thin and emaciated and died.

Autopsy was refused so the real cause of death was not determined although it would seem that it was probably caused by urinary involvement from extension up along the ureters.

" The Frei antigen was continued here for some time and in addition two courses of sulfanilamide and antisyphilitic therapy for weeks were given. Before I saw her deep x ray therapy had been applied to the lesion. It was my opinion that the lesion might be cured by wide excision of the affected area and this is still my opinion. It was my belief that operation had been radical enough but apparently some of the disease was left behind and gradually progressed."

This case illustrates the progressive nature of the disease its seriousness, the later development of carcinoma with a fatal termination despite all known methods of treatment, including an abdominoperineal resection which here was obviously performed too late to be of value.

HISTORICAL REVIEW

It seemed worth while therefore to review briefly the historical background of the disease and excision procedures and to report 26 personal cases in which we have resected the rectum preserving the anal sphincter.

Lymphogranuloma venereum was isolated in 1913 as a separate clinical entity by Nicholas, Favre and Durand. Frei (6) greatly advanced interest in the disease when he introduced his intradermal diagnostic test which has proved to be specific. Hellerstrom showed that lymphogranuloma venereum was due to a filterable virus. Frei and Koppel (8) and Bensaude and Lambling proved that the majority of non neoplastic strictures of the rectum were due to this disease.

Larsen in 1849 described inflammatory strictures of the rectum in 11 women.

The first case of excision of the rectum for stricture was reported in 1864 by Glaser. His patient had a recurrence and 2 years later he had to make a colostomy. During the next 20 years several surgeons reported a few additional cases but because the operation was difficult and there were recurrences, the operation was discarded.

To Professor Henri Hartmann (10) of Paris, goes the credit for recognizing the seriousness of the disease and giving it careful and prolonged study in all of its surgical aspects. Early in his career Hartmann performed 16 external rectotomy operations. In no case did it cure the patient, but it relieved

them and all of them continued to suppurate and suffer a certain degree of incontinence. For this reason he gave up the operation. Later in 1895 Hartmann and Queiro (13) reported a series of 35 cases, most of them their own in which no excision of the stricture was done. They concluded that the operation of excision seemed to tend toward ultimate recovery. Since then for a period of approximately 40 years Hartmann has advocated resection and has successfully performed the operation in many strictures of the rectum. Careful histopathological studies were made of each resected specimen. In 1930 he reported excision operations upon 66 patients for rectal stricture. An abdominoperineal amputation was made in 6 cases and 3 patients died a mortality of 50 per cent. At first the perineal amputation was made without considering the sphincters and in 56 cases the results were only fair. One of 9 such patients died. Only 4 patients could be followed and 2 of them were cured. The best results were made by intrasphincteric amputation, and he stated "Real cures can be obtained in most strictures not accompanied by profuse suppuration. Among 27 such amputations there were only 2 deaths, and he states

"It was possible to follow 31 of the patients. There was a recurrence of the stenosis in 3 cases and a colostomy was necessary in 1 year, 4 years, and 6 years after amputation. Eight patients were improved but continued to suppurate and one of them died at the end of 13 years with diarrhea and swelling of the face, probably due to amyloid degeneration. Twenty patients were cured of their rectitis and there was no stenosis or separation of the mucosa. An endoscopic examination of the rectum showed that the mucosa was normal in appearance. All of these patients were continent, but the continence was not absolute and when they had diarrhea they were not able completely to retain their feces. Two of the patients complained of having moisture around the anus.

In Hartmann's *Chirurgie du Rectum* published in 1931 he has an extensive chapter entitled *Rectitis Stenosantes* which includes his experiences and many detailed case histories, and he concludes

"The first thing, in contradiction with the recognized opinion, is that excision of the rectal stenosis may give complete and definite recovery. Colostomy indicated from the first, when the rectitis

is abundant with suppuration and complicated with multiple fistulas ameliorates the state of the patient considerably and makes life bearable. It may be wholly insufficient if the suppuration continues abundantly and above all if hemorrhages take place.

In 1926 De Roche reported 21 cases of fibrous strictures of the rectum in which resection was done with one operative death. Follow up results were obtained in 8 cases which were as follows after 1 year 1 suppurated, 1 had to be dilated 3 had relapsed and 3 had maintained excellent results.

Dimitriu and Stoia in 1933 reported 25 cases of abdominoanoanal excision with preservation of the sphincter mechanism. Nineteen patients were cured 3 died and 3 recurred.

It seems that French surgeons were the first to recognize the essential need for surgical treatment of serious strictures of this type. The surgical treatment aimed at (1) correction of the stenosis, and (2) extirpation of all diseased tissue to prevent spread.

Lockhart Mummery who represents the best English opinion in his textbook in 1934 states

If a stricture is noted near the anus very excellent results in suitable cases are obtained. A modification of Whitehead's operation is all that is necessary to get rid of the stricture. It is not easy as a fibrous tissue outside the stricture prevents the separation of the mucosal membrane in the normal manner and this renders it difficult. When the stricture is more than one inch from the anus, the method is not possible and a formal excision similar to that for malignant disease is necessary. The operation of excision of a portion of the rectum for nonmalignant stricture is not one to be lightly undertaken, as a stricture serious enough to warrant removal of this portion is almost certain to be associated with a dense amount of fibrous tissue in the surrounding parts, which makes the anatomy quite abnormal, and may cause great difficulty in separation of the rectum.

In none of his published works has Lockhart Mummery shown any enthusiasm for the excision operation as a method of treatment for rectal strictures.

Martin, in 1933 reported a series of 227 rectal strictures in negro women and concluded that the disease is incurable and tends toward an inevitable fatal termination, but nowhere does he suggest a definite method of

treatment. Spiesman Levy, and Brotman in a study of 183 strictures from the Cook County Hospital reported 2 resections one done by Davison and one by McNealy.

Edwards and Kindell reported satisfactory results in 6 cases in which they made a preliminary colostomy and later did a perineal extirpation of the diseased rectum according to the technique described by Lockhart Mummery for rectal malignancy.

Barber and Murphy from Bellevue Hospital reported 35 cases of resection 4 were one stage sacroperineal and 31 were abdominal colostomies followed by sacroperineal resections. Five of their 35 patients died, which gave a hospital mortality of 14.3 per cent. These 5 were extreme cases and there were no immediate postoperative deaths. They stated that in 2 patients who had had an original colostomy the colostomy ceased to function after the granulomatous process crept up to and involved the sigmoidostomy stoma. They made a permanent abdominal anus in their advanced cases. Two cases showed carcinoma.

Woods and Hanlon in 1944, reported from the Cincinnati General Hospital 35 cases treated by rectosigmoid resection. In analyzing 192 cases of rectal stricture they stated that 'colostomy has been usually employed at an advanced stage with no constant success in arresting the disease. They performed colostomy without resection in 34 cases 2 died of postoperative complications radical resection was performed in 35 cases. With no operative deaths, abdominoperineal resection was performed 23 times with good results in 20 of the 23 cases. In the perineal resection of the Lockhart Mummery type in 9 cases the results were good in 5 poor in 2 and fair in 2. They emphasize, however that the resection operation is a procedure of considerable magnitude and should be undertaken only after conservative methods fail. They conclude though, that the abdominoperineal resection is a satisfactory operation and that they have never seen resolution of firm fibrous strictures.

From the above résumé and from a study of other available literature, it becomes apparent that the general attitude in this country and in England up until about 5 years ago was

that these cases were best treated by dilatation if the lesion was apparently mild, and by a permanent colostomy if the patient's condition was at all serious. Only in the reports from the Baltimore City Hospital by Edwards and Kindell from the Bellevue Hospital by Barber and Murphy and from the Cincinnati General Hospital by Woods and Hanlon have American surgeons shown any indication of their appreciation of the definitive treatment of this serious malady.

Our own experience coincides with that of Hartmann, namely that drugs dilatation and other simple procedures can in no way take the place of radical surgery in the treatment of advanced rectal strictures. The increased tendency on the part of some American surgeons to use excision as an operation of choice indicates their recognition of this fact.

At Harlem Hospital we have had 4 deaths following dilatation of rectal stricture while Woods and Hanlon report 7 deaths following the same procedure at the Cincinnati General Hospital. There is no doubt that many deaths as a result of bougie or instrumental dilatation of benign strictures of the rectum have occurred throughout the country but the cause of death has not been so reported.

Licione was the first to report carcinoma as a sequela of rectal stricture; he recorded 2 cases. Woods and Hanlon reported 3 cases, and 3 cases were reported by Barber and Murphy from the Bellevue Hospital. We found records of 3 cases in the hospital and one of us (L. T. W.) observed another case in private. It is noteworthy therefore that the incidence of a superimposed carcinoma of the rectum upon this apparently benign lesion occurs much more frequently than is supposed.

We have used, in the treatment of these strictures every form of mild treatment excepting x ray and this includes finger dilatation dilatation with Wales bougies, posterior proctotomy in some instances, in rare cases Keller's tunnel grafts sulfonamides, Frei antigen diathermy carbon dioxide snow none of these availed but little in the serious cases. We have found that posterior proctotomy operations, followed by bouginage, give temporary relief but that in the final analysis they serve only to spread the disease

and to make the stricture more rigid. Levy Holder and Bullowa, from our out-patient department, reported good results with sodium sulfaniloyl sulfanilate but the end-results have not been up to expectations in fact, some of the patients so treated are still coming back to the clinic and no doubt others have wandered off to other hospitals.

Many of the unconsidered factors in the difficulties of the palliative methods of treatment of strictures particularly in colored people are due probably to the fact that certain fibrous tissue reactions such as keloids and elephantiasis, are predominant in colored races. Rosser used this observation to explain the frequency of rectal strictures in negroes and postulated that they had a tendency toward fibroblastic tissue hypertrophy. This has been our experience.

Colostomy has been the ultimate procedure used in most clinics when the patient's life is obviously threatened. Many colostomies have been performed by us for relief of benign rectal strictures in females. Seven patients entered the hospital with colostomies done elsewhere; 5 patients showed a stricture of the colostomy opening after operation; 4 patients needed another colostomy. Some authors have claimed that colostomy alone tended to cure or soften the strictures. This is, of course, absurd. It is true that ulceration, secondary infection and toxemia resulting therefrom have been lessened by diversion of the fecal stream but we have never found that colostomy cured a real fibrous stricture of the rectum.

Experienced surgeons know that colostomy *per se* is not without certain specific dangers. This is true even when performed by surgeons of ability and great experience. These dangers are first, stenosis or a stricture of the colostomy opening. Such stricture occurs a few months or a few years after the artificial anus has been made. It happened in 5 of our cases and in 2 patients admitted from other hospitals. The second danger is retrograde or antero-grade herniation of the bowel. This herniation occurs when the opening in the abdominal wall is too large. If the proximal segment of the bowel is mobile an antero-grade herniation occurs. This occurred in 4 of

WRIGHT ET AL. RECTAL STRICTURES

our cases. If the distal end of the sigmoid is mobile a retrograde herniation occurs this happened in 3 of our cases and in 2 patients admitted from other hospitals. It is impossible to foretell whether any of the above complications will or will not occur following a colostomy. We have seen secondary operations performed and deaths occur because of all of the above complications. Therefore, it is our conclusion that colostomy although successful in some instances, is not and cannot be the best surgical answer to this problem. At best, it can serve only as a definitive method of treatment when no other rational option is available. Aside from the surgical complications many patients will go on to their deaths and refuse help rather than have an artificial anus, and particularly is this true in young women in the early decades of life. It is likewise true that when the disease involves the entire rectum or extends up to the sigmoid, one has no choice but to advise a permanent colostomy with or without a sacroperineal resection otherwise the patient unquestionably dies.

We have seen patients with dangerous and serious sequelae which followed colostomy operations, even in the hands of experts. When there was marked stenosis of the colostomy opening—and these cases are numerous in colored people—we have had to perform another colostomy in the transverse colon. Many strictured colostomy openings develop abscesses and fistulas. We have also had to treat some of the so called perineal resections done at other hospitals for serious late infection, which in one instance, extended up to the fifth dorsal vertebra (Figs 1 and 2).

The seriousness of this disease is further emphasized by Kassebohm and Schreiber who have reported from the Obstetrical Service of Harlem Hospital deaths due to the rupture of the rectum during spontaneous delivery and instrumental delivery and they consider it a very serious complication of pregnancy. In fact, they recommend either therapeutic abortion if recognized early or cesarean section if late.

We agree totally with Hartmann that the treatment of choice of low strictures of the rectum is excision. We further believe that as

our technique improves the mortality will become lower. It is also our opinion that surgeons in clinics who see large numbers of these cases will eventually come to this conclusion.

CASE REPORTS

The first patient was seen and operated on in private by one of us (L.T.W.) A brief abstract of her history follows.

C. M. colored female, married, 34 years of age mother of one child 12 years of age was first seen in the office in November 1924 at which time she complained of an abscess near the rectum. She was emaciated, anemic, nervous, and weak. The only other essential point in her history was that she had a history of having 7 operations for perirectal abscesses during the previous 5 years. Constipation, deformed stools and at times passage of blood and mucus from the rectum completed her history. Examination revealed a stricture of the rectum which would barely admit a No. 24 F catheter. Two fistulous openings were present on the right side of the rectum. The perineum showed perianal and perirectal thickening. In December, 1924, posterior proctotomy with wide excision of all fistulous tracts was done. In October 1925 left inguinal colostomy was performed. In January 1926, the rectum was excised preserving the external sphincter mechanism according to the method of Victor Panchet. Convalescence was slow but uneventful and complete healing of the perineal wound did not occur for a period of 2 months. This patient frankly stated that she would prefer to die rather than have a permanent artificial anus and that she would willingly undergo any risk that would offer her a chance of health. Later the colostomy was closed. In the spring of 1945 19 years after her original resection this patient reported that she was in excellent health.

This first patient, with several others was demonstrated at a symposium given in 1938 by the surgical department of our hospital in honor of Dr. Wilhelm Frel. Because of the satisfactory result in this case we were stimulated to use the method beginning in 1931 on the surgical service of Harlem Hospital, and the authors of this article constituted an in-door group for the clinical study of these cases. All of the second stage operations were performed wholly or in part by the senior author (L. T. W.).

We have used this operation in 26 cases. The following is an illustrative case referred to the senior author.

J. G. colored woman 26 years of age married 5 years, never pregnant, husband living and well.

SURGERY GYNECOLOGY AND OBSTETRICS

History of rectal bleeding, pain during defecation with a discharge of pus and mucus from the rectum during the past 4 years. She had been hospitalized on two or three occasions for dilatation of the stricture without much permanent relief. She had been having chills and fever off and on for the past 2 years. Physical examination revealed a tight annular stricture of the rectum one half inch above the anus which did not admit the tip of the little finger. The blood count showed 4,000,000 red blood cells, 86 per cent leukocytes, 74 per cent polymorphonuclears. The Frel test was strongly positive. Urinalysis showed occasional white blood cells and red blood cells. Blood chemistry creatinine 1.2 urea nitrogen 13 sugar 75 Wassermann test negative. Colostomy was performed May 11, 1936 (Fig. 3). She was discharged May 31, 1936.

She returned on October 5, 1936 for the second or excision stage of operation, which was performed on October 6. Pathological report by Dr. Solomon Weinstein: large mass of tissue 5 by 5 by 5 centimeters. The mass had an irregular nodular surface, with moderate hemorrhagic discoloration of the surface. The mass itself showed marked fatty infiltration and on cut surface had a grayish white fibrous appearance and extremely firm consistency. Microscopic diagnosis acute and chronic inflammation of the rectum with fibrosis. She was discharged on December 6, 1936. On March 1, 1937 she returned for closure of the colostomy and was discharged May 22, 1937. Figure 4 shows the condition at the time of her discharge. In reply to a letter of inquiry her referring physician wrote on December 14, 1943 as follows:

I examined Mrs. G. in 1943 for some other condition. At that time she had no gastrointestinal symptoms whatsoever. Examination showed a somewhat patulous but perfectly competent anus. At the end of the examining finger rectally there was a slight degree of nonobstructing rectal constriction. The patient weighed 35 pounds more than she did in 1936, and she felt very well.

Examination in our follow-up clinic in February 1944 was as follows: no trouble with the rectum since closure of the colostomy in 1937. She has full control of her bowels. On examination she showed a red linear scar in the suprapubic region from hysterectomy operation which she had on September 24, 1943 for fibroid uterus. The skin around the anal margin was soft, the mucosa red and healthy. There was no stricture or ulceration.

In the 26 cases, in which the above procedure was carried out, 2 deaths occurred in the hospital. One death occurred on the day of operation—the resident surgeon had failed to appreciate the fact that the patient was in secondary shock and needed a transfusion. Another patient died of peritonitis following closure of the colostomy by one of the asso-

ciate surgeons on the staff death, of course, was not attributable to the excision operation. We have been able to follow 12 patients, 7 to 19 years after operation and the result in 8 cases was satisfactory. One patient still had sinuses on each side of the rectum which intermittently drained a slight amount of pus. This patient showed osseous involvement and was reported as such (28). Another patient showed a slight tendency toward rectal prolapse where the mucosa had separated from the skin margin. One patient showed a stenosis at the anal margin. One patient became psychotic. It is of interest to note that in all of these patients, excepting the one with the draining sinuses, the disease was completely eradicated also that 8 of these patients had as excellently functioning anus with control over their bowels except when they took laxatives.

TECHNIQUE

The operation was performed in three stages in 24 of the 26 cases. The following drawings—Figures 5, 6, 7, 8, 9, 10 and 11 which are after Pauchet, and No. 12 which is diagrammatic—illustrate various steps in the operation. The first stage is the making of a temporary colostomy. After the colostomy and when the general condition of the patient has improved to the point where it is felt that she can withstand a resection, an effort is then made to disinfect the distal sigmoid and rectum in so far as possible as a preliminary to resection of the rectum. The second stage is the stage of resection and after this has healed, the third stage is to close the colostomy. The time interval between the different stages varies according to the clinical condition of the patient.

Early in our studies we used baryum enemas to determine the length and extent of the strictured area, but we soon found that its use was more a disadvantage than an advantage, the reason being that, although the procedure did give us some information as to the height of the stricture the baryum often became inspissated above the stricture and was extremely difficult to remove. We later learned to investigate the extent of the stricture when the abdomen was open while we were performing the colostomy. Before any operation is

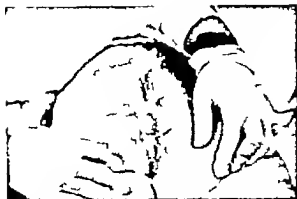


Fig. 1. Patient C. A. Appearance on admission November 30, 1938, of an abdominoperineal resection of a stricture performed at another hospital 6 months previously on June 3, 1938. She was emaciated, weak, and dehydrated. The infection had burrowed upward along the supraspinous ligament to the level of the fifth dorsal vertebra.

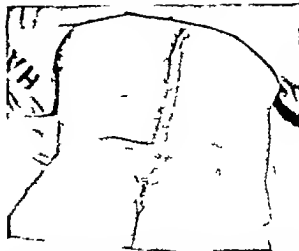


Fig. 2. Patient C. A. Appearance at time of discharge March 1, 1939. The entire area of infection was opened widely and packed with zinc peroxide, which resulted in healing.

undertaken we take great pains to explain to patients that they may have to go through life with a permanent artificial anus in the event we should find at the time of the colostomy operation that the stricture extends so high that it is not resectable. Thus the patient understands thoroughly beforehand and agrees to and it is also understood that if the stricture is one that will lend itself to resection that will be done and that eventually the colostomy opening will be closed.

Two low strictures were resected in a one stage operation without colostomies having been previously performed (Figs. 13 and 14). In these 2 cases it was possible to resect the rectum without entering the peritoneal cavity and the healthy rectum was brought down intrasphincterically and sutured to the surrounding skin. The only trouble with this procedure and for that reason we gave it up is the fact that although it cures the patients of their disease and their stricture it also brings the cervix of the uterus down to the vaginal introitus, and to this condition the patients later objected strenuously.

In performing a colostomy for stricture of the rectum the sigmoid and rectum are examined carefully as to the length of the stricture, the extent of infiltration of the disease and a search is made for enlarged lymph nodes; this information is used as a basis for deciding for or against resection. In a few



Fig. 3. Photograph of temporary colostomy. Patient J. C. May 31, 1936.



Fig. 4. Patient J. G. Appearance of operative site 3 months after excision stage. Condition unchanged when examined 8 years later.

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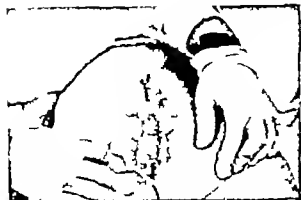


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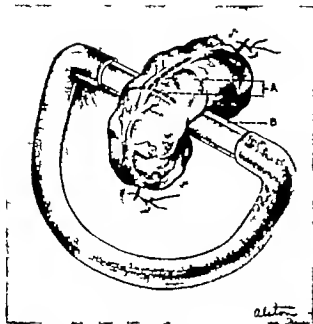


Fig. 5. Drawing of colostomy at time of opening. A Lines of incision used. B Glass rod or Makins's which holds up the loop.

cases not included in this series, the sigmoid was found to be plastered down to the posterior abdominal wall and the rectum and sigmoid exhibited thickening of their walls and luminal narrowing which rendered them

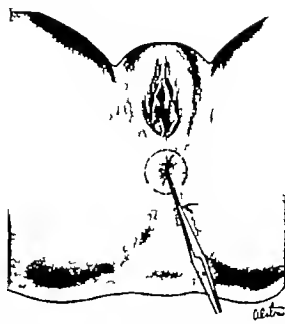


Fig. 6. Anus has been closed (its suture, and the line of incision is shown (drawing after Panchet).

obviously unsuitable for resection. In one patient, not included in this series, following resection the new anus cicatrized to such a point that we were not able to close the colostomy. This patient refused further treatment because she was satisfied with the colostomy. There is however no evidence of active disease around the rectum. In a large number of colostomies performed by us in this disease we have searched carefully for iliac and other glandular enlargement this we have never found. For anemia at first we used ventriculin with iron which helped to overcome the anemia rapidly. All of these patients gave a positive Frei reaction 20 of the 26 gave a positive Wassermann reaction.

In general these patients at the time of the preliminary colostomy were usually emaciated, toxic, and in very poor general clinical condition. They were allowed to go home until their clinical condition improved, which was 3 or more months, after which they were brought back for the second stage of the operation which was the excision of the rectum with preservation of the sphincter. After the latter stage which required usually from 4 to 8 weeks to heal the patients were allowed to go home for a few weeks, if they so desired,

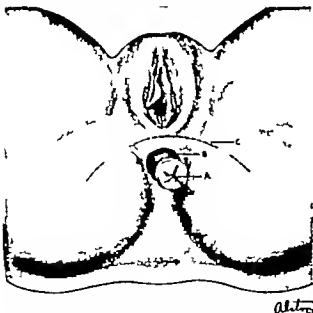


Fig. 7. A Button of skin around anus. B Sphincter ani muscle exposed following dissection of anal mucous membrane. C Line of curvilinear incision (drawing after Panchet).

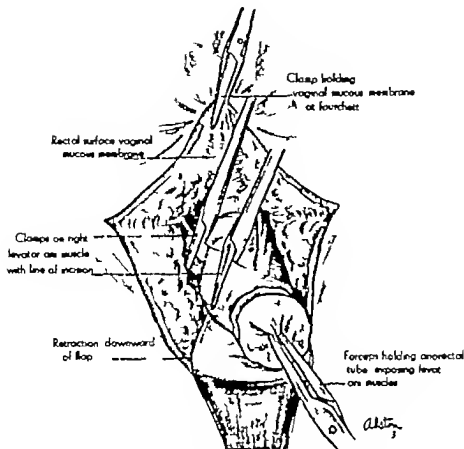


Fig. 8. The lower flap contains the sphincter and muscle (drawing after Pauchet)

after which they would return to have the colostomy closed. It should be pointed out that these patients because of their poor clinical condition before the colostomy and because of the magnitude of the second or excision stage require a longer period of hospitalization than do most patients and during this time they require careful supportive treatment.

The technique used was not original with us, but we followed in the main the one described by Pauchet. Preliminary to the resection stage of the operation it was our custom at first to instill thrice daily 2 ounces of a 10 per cent solution of argyrol into the distal segment so as to render it as bacteria free as possible; later we irrigated the rectum through the colostomy opening with a 1:5000 solution of zephiran. Ether anesthesia was used.

The anal sphincter is dilated fully; the anus is closed with a heavy silk suture and an area of skin about the size of a silver dollar is dissected up exposing the external sphincter

muscle. The mucous membrane lining the anal canal is freed with scissors and blunt dissection just as in the Whitehead operation for hemorrhoids. The stricture is usually located at the junction of the rectum and the internal opening of the anal canal. A curvilinear incision is made that extends from near the tuberosity of the ischium on one side upward to the fourchette and then downward to the area over the tuberosity of the ischium on the other side. The anterior wall of the rectum is then separated from the posterior wall of the vagina. At times the rectum is unavoidably opened at this point, but where this has happened no serious infection has developed.

The levator ani muscles on each side are divided between clamps close to the rectum and ligated. At this time one cuts through much scar tissue which bleeds and oozes very freely; this hemorrhage is controlled by the frequent use of hot pads. After a partial dissection of the stricture from its surrounding

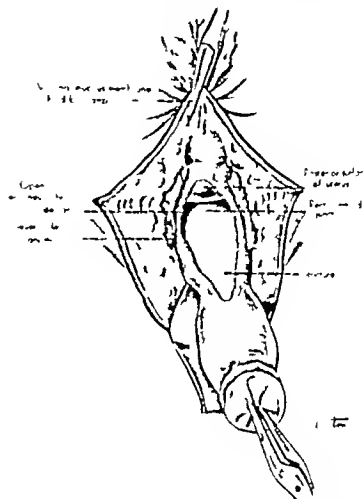


Fig. 9. The pouch of Douglas has been opened (drawn after Lauchet).

tissues the apron of skin which carries in it the sphincter muscles is allowed to fall forward and downward. The firm rectococcygeal ligaments are divided and retractors hold the skin flap downward. The rectum is then easily freed in the hollow of the sacrum and its lateral fascial attachments above the levator ani muscles are divided.

The peritoneal cavity is entered through the pouch of Douglas. The rectum is pulled down to a point above the strictured area. The superior hemorrhoidal vessel and all other bleeding points are carefully ligated. The diseased portion of the rectum is excised at a point through healthy rectal tissue. The proximal end of the rectum is brought down intrasphincterically and its margins are sutured to the skin edges with interrupted black

silk sutures which bring the rectal mucous membrane in direct contact with the skin. Two Tenrose or cigarette drains are placed into the peritoneal cavity, one coming out at the lower angle of the wound on each side as shown in the illustration (Fig. 11). A piece of vaseline gauze is placed in the new anal canal.

The patient is given a blood transfusion, 500 cubic centimeters of blood immediately after the operation and she is watched very closely during the next 4 hours for the possible development of secondary shock. If the patient during this time goes into shock again another transfusion is given, usually 200 or 300 cubic centimeters of blood. During the same immediate postoperative period an intravenous drop of normal saline solution is given. The following day the patient's bed is placed in

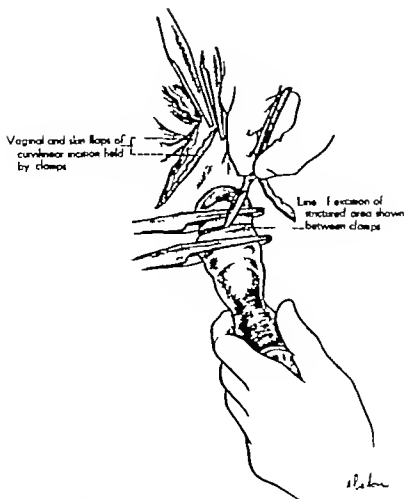


Fig. 10. Division of the rectum proximal to the stricture (drawing after Pauchet)

high Fowler's position. After the rectal operative site is healed the colostomy is closed.

OBSERVATIONS

In performing the preliminary colostomy it is important to use the segment of sigmoid

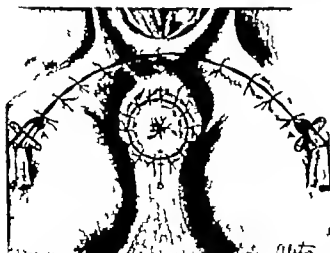


Fig. 11. 1 Drain, which extend up into the pouch of Douglas. 2 New anal canal (drawing after Pauchet)

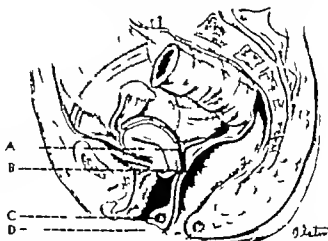


Fig. 12. Diagrammatic cross-section view at end of operation. A Cut edge of peritoneum. B Rectum. C Sphincter and muscle. D Suture approximating mucous membrane to skin.



Fig. 3. Patient H. F. Photograph of Introltus of patient who had a one stage resection 4 years previously. A The cervix at the opening of the vaginal canal. This patient became pregnant and was delivered by cesarean section, year after resection of the rectum. Thirteen years later this patient has a well functioning anus but her cervix is still at the introltus. In this condition she has refused to have corrected.



Fig. 14. Patient N. H. Operative site 2 years after one stage resection. No evidence of disease. Well functioning anus and rectum.



Fig. 15. Operative specimen patient C. W. age 24 years. Stricture complicated with rectovaginal fistula. First stage December 4, 1936. Second stage May 1937, at which time specimen was removed. Colostomy closed February 9, 1938.

that is at the highest point above its mobile part. This step will permit the segment to be drawn down when the rectum is resected. In one instance this point was not observed when a colostomy was performed and, during the resection stage of the operation, after the rectum was freed and the diseased portion excised, there was not sufficient mobility to permit the bringing down of the healthy end of the rectum to the skin. This patient developed a psychosis upon learning that she would have to keep her artificial anus and she was transferred to a mental institution where she died. It is imperative that the highest mobile point of the sigmoid be the site of choice for the performance of a preliminary colostomy if the structure is resectable. If the structure is not resectable the making of a colostomy at that site for a permanent artificial anus is dangerous because there may be the development, later of a retrograde herniation in a few cases.

With the advent of the sulfonamides, particularly sulfasuxadine which has been a boon in lessening infection in the large bowel, it is possible that we may be able to do these resections in one stage and open the peritoneal cavity without danger. This we have not yet attempted. We still believe that the three



Fig. 16 Patient M. B. Anal tumor, stricture of rectum, and fibroid of uterus. Colostomy and hysterectomy May 14, 1932. Resection of tumor with stricture by dividing lower third of vagina and sphincter muscles. Closure of colostomy October 8, 1932. Follow-up 12 years later showed good results.

stage operation of preliminary colostomy followed by resection when the clinical condition of the patient has improved and followed by the closing of the colostomy is the procedure which gives the patient the greatest protection.

Sometimes these patients present tumor masses around the anus which have to be excised at the time of the second operation. Figures 16 and 17 show the external appearance in 2 cases in which resection was done and the end results were excellent.

Dr. Milton J. Schreiber from the obstetrical service reports that he has delivered spontaneously 4 of the patients who have had excision operations in this series without any ill effects.

We have had no experience with Hartmann's method of perineal resection, the Lockhart Mummery method of resection as used by Edwards and Kindell and Barber and Murphy and the modification as used by Woods and Hanlon. In all of our cases we have preserved the sphincter, a point which Hartmann later conceded to be important although his operative approach was sacral rather than the approach which was used by Pauchet.

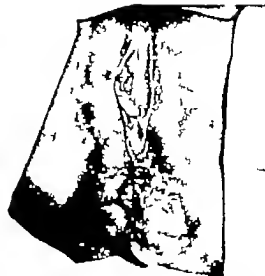


Fig. 17 Patient V. B. Anal condition at time of admission in 1934. Three stage operation. Well functioning anus in 1945 at which time she was on the gynecological service for a pelvic mass. No signs of anorectal disease.

It should be clearly understood that the operation of excision is a very serious operation and one to be used only in selected cases and by surgeons of experience. It should not be performed by the surgeon who does this type of operation only occasionally although we are certain that as a given surgeon's operative experience with the disease grows his results will improve. It is hoped that early diagnosis and the use of chemotherapy will obviate the necessity for the use of surgery in these cases before a true rectal cicatricial stenosis has occurred.

CONCLUSIONS

1. Resection of the rectum with excision of the diseased area and preservation of the sphincter is the treatment of choice in certain selected cases of fibrous stenotic strictures of the rectum.

2. Permanent colostomy may have to be performed as an operation of necessity when the disease is so extensive that it cannot be resected with ease.

3. Abdominoperineal resection may be justified in certain cases in which the stricture extends so high that a sphincter preservation operation cannot be done.

4. Twenty six cases in which resection of the rectum with preservation of the sphincter was performed according to Pauchet's technique are reported with 2 immediate deaths.

and 1 later death. These 2 immediate deaths were preventable and cannot be ascribed to the operation *per se* but to our inexperience. Follow up of 12 cases shows that the disease was cured in all but one and this one present fistulous openings which drain intermittently due to bone involvement.

5. Pauchet's operation has proved a satisfactory procedure in our hands and is worthy of further trial.

6. Two very low strictures were resected in one stage and they resulted in complete cure.

7. Early diagnosis in our opinion followed by an excision operation is the best treatment for fibrous strictures of the rectum.

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LIGATION OF THE INNOMINATE ARTERY FOR INNOMINATE ANEURYSM USING RUBBER BANDS

Report of a Case

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OF the fewer than 100 operations performed on the innominate artery since Valentine Mott's initial report in 1818, approximately 25 per cent have been for innominate aneurysm. Greenough in 1929 collected from the literature 91 ligations or attempted ligations of the innominate artery; only 17 were performed for aneurysm of this vessel and in only 13 was the artery actually tied. In 1937 Rundle added 8 cases to Greenough's 13 (3 of these Greenough had listed as subclavian aneurysm)¹ and Brock in 1941 added another. From these reports and including the present case it appears that the innominate artery has been ligated some 23 times for aneurysm.

The relative infrequency of ligation of the innominate artery for aneurysm is understandable because of (1) the rarity of the condition (innominate aneurysm accounts for less than 3 per cent of the total), and (2) the high mortality of the operation (Table I). A successful case was not reported until 1911 by Sargent although Cunco according to Guinard successfully ligated the innominate artery for aneurysm in 1905. Many more successful ligations have been performed during the past 25 years but the procedure remains hazardous with secondary hemorrhage still the chief cause of death (Table II).

Greenough gives a detailed description and analysis of the types of operations employed on the innominate artery including proximal or distal ligation or both, ligation of the innominate and subclavian or carotid vessels, triple ligation of the innominate, subclavian and carotid arteries, triple ligation and excision of the sac and innominate, carotid and

TABLE I—MORTALITY IN 28 CASES OF OPERATION ON THE INNOMINATE ARTERY FOR INNOMINATE ANEURYSM

	Ligation	Mortality	Attempted ligation	Mortality
Greenough	13	6	4	4
Rundle	8	3	1	1
Brock	1	1	0	0
Trent	1	0	0	0
Total	23	10 (43.5%)	5	5 (53.5%)
Total number of cases	28			

vertebral ligation in which silk, hemp, ox aorta, ox peritoneum, kangaroo tendon, catgut, catgut chromic, catgut, horsehair, silver wire and many other materials were used as ligatures. He concludes that multiple ligation is advisable, combinations including the subclavian surpass those with the carotid and the vertebral should not be included.

After careful evaluation of the operative treatment of innominate aneurysm, Rundle reaches similar conclusions: (1) if an attempt is to be made to ligate the innominate trunk, it is essential to split the sternum; otherwise access is inadequate and the ligature may fail to occlude its lumen; (2) simple proximal ligation as a method of treatment is most unsuitable while necessitating as thorough an exposure as the more complete operation; it gives the poorest results and is too prone to be followed by cerebral vascular complications.

In any type of ligation of the innominate trunk, there are two circulations to consider:

TABLE II—CAUSES OF DEATH IN 15 CASES OF OPERATION ON THE INNOMINATE ARTERY FOR INNOMINATE ANEURYSM

Secondary hemorrhage	7 (46.6%)
Cerebral complications	3
Shock	2
Tracheal compression	1
Traction on aorta	1
Uremia	1
Total	5

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Early reports of ligation of the innominate artery for aneurysm are frequently difficult to interpret because of the failure of the authors to describe the exact location of the lesion.



Fig. Anterior and lateral views of the patient 10 days after operation. The operative scar is clearly visible. The aneurysmal mass no longer pulsates but is approximately the same size as on admission.

the peripheral and the cerebral. Greenough in 75 ligations found no cases of gangrene of the homolateral arm although there were several cases of atrophy. There were 7 deaths from cerebral lesions, some of which must be attributed to ischemia.

Although the recommendations for surgical therapy outlined above are sound they are not always applicable, a fact well illustrated by the following case which presents several unusual features, namely (1) the approach to the innominate artery was through the chest rather than the sternum since it was feared that manipulation of the sternum or clavicle would result in the tearing of the wall of the aneurysm, (2) rubber bands were used to ligate the vessel, and (3) the aneurysm completely disappeared following proximal ligation of the innominate trunk.

CASE REPORT

R. W. A. 51137, 51 year old colored male, was first seen at the Duke Hospital November 11, 1940. At that time he had a strongly positive blood serology and spinal fluid. A diagnosis of central nervous

system syphilis was made and the patient referred to the local Department of Public Health where he received a course of antilimetic therapy.

He returned to the clinic May 31, 1944, stating that 1 month prior to his visit a small knot the size of a walnut had appeared suddenly at the base of his neck on the right after a severe coughing spell. The cough had continued and the "knot" had grown rapidly in size. He had no obstruction to his breathing but had noticed some hoarseness and dysphagia. He complained also of throbbing headaches which seemed to be synchronous with his heart beat.

Physical examination revealed fixed pupils, a blood pressure of 148/110 in the right arm and 14/100 in the left, a heart slightly enlarged to the left with an irregular rhythm due to dropped beats, and a late diastolic murmur over the aortic area. Just above the clavicle and resting on it was a large pulsating definitely expansile mass measuring approximately 10 by 12 by 7 centimeters (Fig. 1). The mass extended beyond the midline although it was predominantly on the right. The trachea was markedly deviated to the left and laryngoscopic examination was unsuccessful. The size of the aneurysm prohibited ante flexion of the head.

Röntgenograms of the chest (Fig. 2) showed slight enlargement of the heart to the left with some tortuosity of the aorta but no definite aneurysm of this vessel. A shadow in right supra cardiac region



Fig 2 a, Preoperative roentgenogram of the chest showing the shadow in the right suprasternal area characteristic of an enlarged innominate artery. Slight enlargement of the heart to the left and tortuosity of the aorta but no definite

inite aneurysm of this vessel. The trachea may be seen far to the left. b Seventeenth postoperative day. Roentgenogram of the chest showing the elevated diaphragm on the right.

was characteristic of an enlarged innominate artery. The trachea was displaced considerably to the left.

A diagnosis of aneurysm of the innominate artery and possibly the right common carotid artery was made and the patient referred to the surgical clinic for consideration of ligation of the innominate artery.

He was admitted to the surgical service on June 16, 1944, stating that the mass in his neck had increased in size since his last visit to the clinic. The physical findings were essentially unchanged over those last recorded except for a slight increase in the size of the aneurysm.

The accessory clinical findings were as follows: hemoglobin 13.4 grams (86%), red blood count 4,160,000, white blood count 6,360, blood Wassermann reaction positive, Kahn positive, Kline and Mazzini tests negative. Spinal fluid tests showed Wassermann reaction 00000, colloidal mastix test 0000000, Pandy negative, cell count 0.

Fluoroscopy and films of the chest showed the changes described. The electrocardiographic record was indicative of coronary artery disease.

A diagnosis was made of syphilitic aneurysm of the innominate artery, syphilitic cardiovascular disease with cardiac enlargement and myocardial damage from coronary involvement, aortitis and dilatation of the aorta.

During the 9 days the patient remained in the hospital before operation the aneurysm increased visibly in size, and rupture appeared imminent.

Therefore, in spite of electrocardiographic evidence of coronary involvement and the attendant high operative mortality, ligation was recommended. A week before operation patient was given 2 cubic centimeters of bismuth subsalicylate intramuscularly.

On June 24, 1944, with the patient supine and under pentothal and endotracheal 50 per cent nitrous oxide-oxygen anesthesia, a hockey-stick incision was made over the second rib anteriorly on the right extending vertically along the lateral border of the manubrium to the jugular notch. The underlying pectoral muscles were cut and the second rib exposed and resected as far laterally as possible. The costal cartilage was rongueured away to the sternum; care was taken not to injure the mammary vessels. The pleural cavity was entered through the rib bed. In order to obtain better exposure the third rib was divided laterally and medially. The under surface of the aneurysm could be visualized readily and palpated at the apex of the pleural cavity. The pleura overlying the great vessels was divided and reflected back. The innominate veins and the superior vena cava were separated from the underlying arch of the aorta and the innominate artery and retracted, exposing the greatly dilated innominate trunk which measured approximately 4 centimeters in diameter at its junction with the aorta. By careful manipulation and dissection a large goose-neck clamp was passed under the vessel and a cotton tape placed around the artery (Fig 3). It was feared

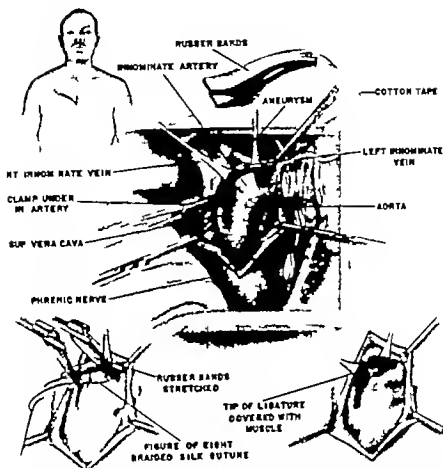


Fig. 3. The right chest was entered through a hockey stick incision over the second rib (left upper inset). The pleura overlying the great vessels was incised, the fat pushed back, the veins retracted, and the innominate artery exposed. A goose-necked clamp was passed behind the artery and two rubber bands pulled through by means of a tape (central cut). The rubber bands were stretched and sutured anteriorly using heavy braided silk (left lower inset). The ends were trimmed and the protruding bulb covered with muscle (right lower inset).

that secondary hemorrhage might follow ligation of such a large thin walled vessel with a narrow non elastic ligature. Therefore two new rubber bands 2 millimeters in width and 7.5 centimeters in length were obtained sutured to the tape and drawn under the vessel. The bands were then pulled up very snugly around the vessel and sutured together anteriorly using a heavy braided silk figure of-eight suture. After the lumen of the vessel had been thus occluded there was immediate cessation of pulsation in the aneurysm and right superficial temporal artery and the blood pressure and pulse in the right arm could no longer be obtained. After the rubber bands had been trimmed, a small nubbins remained which lay immediately beneath the innominate veins, and the possibility of erosion into these vessels had to be considered. To obviate this, a piece of muscle was sutured over the stiff protruding ends, to form a soft pad between the ligature and

vessels. The wound was then closed in anatomical layers, with continuous chromic or Dorex suture for the pleura, interrupted double medium cotton for the muscle and fascia and interrupted fine cotton for subcutaneous tissue and skin. Patient stood operation well and returned to ward in good condition.

Following the operation no weakness of the homolateral arm or opposite side was noted. He had a fairly stormy course for the first 3 days due to the development of bronchopneumonia, but on the fourth day following penicillin and sulfadiazine therapy his temperature returned to normal. On the fifteenth day small tender fluctuant areas developed over the crest of the aneurysm. The aneurysm no longer pulsated but had not decreased appreciably in size. Aspiration of the fluctuant areas yielded pus and blood which contained gram positive cocci. To forestall spontaneous rupture, a small incision was made in the skin at the point of aspira-

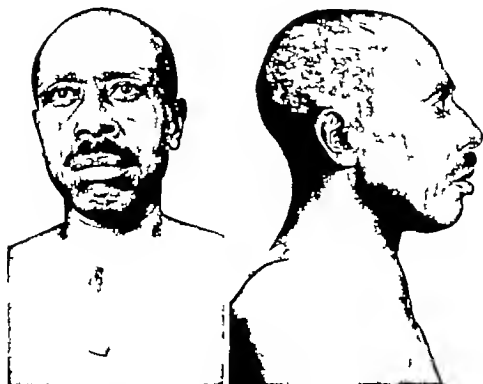


Fig. 4 Three weeks postoperative. Anterior and lateral views of the patient showing almost complete disappearance of the mass. The opening of the small draining sinus can be seen just above and to the right of the jugular notch



Fig. 5 Six weeks postoperative. Anterior and lateral photographs show a further decrease in the size of the mass. The opening of the supraclavicular sinus tract is evident.

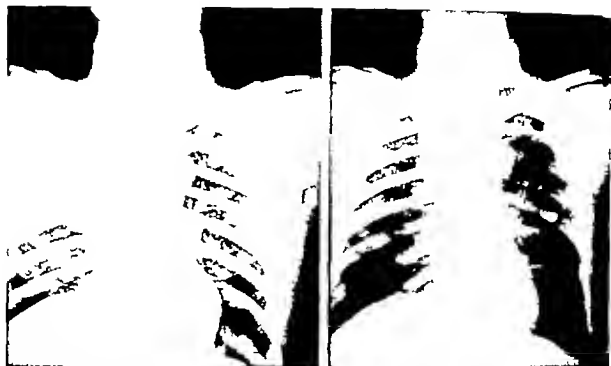


Fig. 6 a, Roentgenogram of the chest made approximately 3½ months postoperatively showing prominent shadow over the right apex displacing the aortic arch.

the left. b, Roentgenogram of the chest made 3½ months after operation showing clearing of the right apex with residual mass in the region of the bronchial artery.

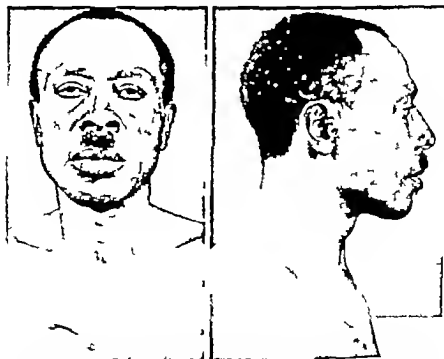


Fig. 7 Ten months postoperative. The mass has completely disappeared and the sinus tracts have healed. The outline of the right sternomastoid muscle is clearly visible. Subjectively the patient is well.



Fig. 8. a, Ten months postoperative. There is a large dense mass in the right supraclavicular area at the site of the ligation. The trachea is practically in the midline. The

diaphragm has descended. b, A kymogram made of the chest reveals no pulsation of the mass which has been described in a.

tion and 100 cubic centimeters of pus, old blood and thrombus were expressed from the neck. No hemorrhage ensued. Following this, the mass in the neck disappeared (Fig. 4). Compresses were applied, the inflammation and induration subsided and healing occurred except for a small persistent sinus. A chest plate on the seventeenth day showed the chest to be clear with the trachea still slightly deviated to the left. The right diaphragm was elevated and fixed from stretching of the phrenic nerve at operation (Fig. 5b). A slight pulse was felt in the right arm on the seventeenth day but the blood pressure could not be recorded. The blood pressure in the left arm was 118/76. Oscillometer studies of the right arm revealed a maximum of 2 units pulsation above the elbow. An electroencephalogram showed no depression of cerebral activity on the right. He was discharged on the twenty first day with instructions to continue his antitubercular therapy.

On August 7, 1944, the patient was readmitted to the hospital complaining of bleeding from the site at which the infected aneurysm had been drained (Fig. 5). Physical examination and chest findings were essentially as on discharge July 14, 1944.

While in the hospital fairly brisk bleeding occurred from the sinus with an estimated blood loss of 500 to 700 cubic centimeters. He was given a blood transfusion. A skioldan injection of the sinus tract revealed only a small pocket at the site of the aneurysm. It was felt that the hemorrhage probably had come from the vessels communicating with the old

aneurysmal sac. An attempt was made to thrombose these vessels by injecting first a solution of 50 per cent glucose and later 5 per cent sodium morrhuate into the tract. Following this no further hemorrhage occurred. The cavity decreased in size and the patient was discharged on August 22, 1944.

On August 26, 1944, the patient was readmitted complaining of a swelling under the old thoracotomy wound which later proved to be an abscess. It was feared at first, however, that it might be due to further hemorrhage and since he was afebrile it was not incised. He was discharged on August 27, 1944.

On September 4, 1944, the patient was readmitted complaining of increase in the size of the swelling under the old incision and further bleeding from the supraclavicular sinus tract. He had some fever and since there was some clouding of the right upper chest on x-ray examination (Fig. 6a) it was decided to explore the mass. On September 7, 1944, the old thoracotomy wound was reopened and a large abscess cavity approximately 8 centimeters in diameter over the apex of the right lung was encountered and drained. The cavity contained a large quantity of thick pus from which nonhemolytic *Staphylococcus aureus* was cultured. The site at which the ligation had been done could not be visualized but it was possible that a small sinus at the bottom of the cavity communicated with it. The patient was discharged improved on September 11, 1944.

On September 28, 1944, the patient was readmitted complaining of dyspnea, substernal oppres-

swon and increasing hoarseness but no further bleeding. Re-examination of the chest by x-ray revealed that the shadow in the right upper chest was still prominent with displacement of the aortic arch to the left. It was felt that there might be a further accumulation of pus over the apex and on September 30, 1944 the old wound was again explored. No pus was found. The patient improved and was discharged on November 3, 1944.

On December 13, 1944 the patient was readmitted complaining of sudden onset of severe coughing which had persisted for 12 to 18 hours. He had coughed up 2 cupfuls of blood and had noticed some bleeding from the empyema drainage wound. Bronchoscopic examination was refused.

Physical and x-ray examinations (Fig. 6b) revealed some clearing at the right apex. While in the hospital he coughed up only a small amount of blood tinged sputum. The exact source of his bleeding was unknown. He was reassured and discharged on December 15, 1944.

On December 22, 1944 he returned to the clinic complaining of coughing up blood. His condition was good and his cough had stopped. He was reassured and sent home.

On January 31, 1945 he was again seen in the outpatient clinic with similar complaints. All draining sinuses had healed. He was reassured and discharged.

On February 12, 1945 he returned to the outpatient clinic stating that he had gotten along well except that he had coughed up a large quantity of blood on 1 occasion. General condition the same.

On April 25, 1945 exactly 10 months after proximal ligation of the innominate artery the patient returned to the clinic for a check-up. He had been receiving weekly intramuscular injections of bi-muth subnitrate since January 3, 1945. He had no dyspnea but occasionally coughed up blood tinged sputum. He had no complaints other than dizziness on leaning his head. He had excellent use of right arm but stated that in cold weather right hand became cold and stiff. Left hand not affected.

On examination the aneurysmal mass had completely disappeared (Fig. 7). The small sinus in this area and the old thoracotomy wound had completely healed. The anterior border of the right sternocleidomastoid muscle was again clearly visible. The upper mediastinum was slightly widened to percussion on the right. The lungs were clear to auscultation. Pulsation in the right brachial and radial arteries were faintly perceptible. Pulsations in the right common carotid and superficial temporal arteries were questionably felt. The blood pressure in the right arm could be heard faintly at 74/60 and 104/74 in the left. Examination of the chest by fluoroscopy and lymphography (Fig. 8a, b) revealed a large nonpulsating mass in the supracardiac area at the site of the ligation of the innominate artery. This mass was interpreted as scar tissue and not as an aneurysmal dilatation. The trachea had almost returned to the midline and the diaphragm had descended and had regained 50 per cent of its motion.

SUMMARY AND CONCLUSION

A case of syphilitic aneurysm of the innominate and common carotid arteries which first appeared after a severe coughing spell has been presented. The aneurysm was ligated proximally at its juncture with the aorta, by the use of two wide rubber bands. Pulsations ceased immediately following ligation although no appreciable decrease in the size of the mass was noted. No weakness of the homolateral arm or opposite side was observed. On the fifteenth postoperative day the aneurysm became fluctuant and was drained to avoid spontaneous rupture. Approximately 100 cubic centimeters of pus and thrombus were obtained without hemorrhage. Following drainage the mass subsided. Two and one-half months later hemorrhage occurred from a persistent sinus tract at the former site of drainage. An attempt was made to thrombose the feeding vessels by the injection of 50 per cent dextrose and 5 per cent sodium morrhuate solutions. Although these measures appeared to be effective in stopping the hemorrhage other complications developed. He returned 1 month later with an infection under the old thoracotomy wound which subsided following drainage. Subsequently both the persistent supraclavicular sinus and thoracotomy wound healed with complete disappearance of the aneurysm. There remains a residual nonpulsating mass at the site of ligation which is believed to be scarring resulting from the irritation of the rubber ligature. Patient has occasional episodes of coughing productive of blood tinged sputum due perhaps to some involvement of the trachea in the cicatricial mass. Except for these episodes the patient states that he feels as well as he ever has.

Proximal ligation of a syphilitic aneurysm of the innominate artery with rubber bands has resulted in complete disappearance of the aneurysm and clinical cure of the patient.

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FAILURE OF THE UROGENITAL UNION

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In a fairly extensive search of the literature very little reference is found to a failure of union between the vasa efferentia of the testis and the epididymis. Hobday mentions that in the horse the epididymis is occasionally found in the inguinal canal while the testicle is in the abdomen. Kaufman (1922) and Windholz (1926) mention complete separation of the epididymis and testis, and Brunzema (1929) found this condition four times in 104 cases of undescended testis. Wilson (1939) records one case in which the testis was in the inguinal canal and the epididymis was in the scrotum. Ombrédanne (1933) describes the separation as occurring occasionally when there is a vestigial testis and Wangersteen (1932) quotes a case of an epididymis with a vestigial structure attached to it which had none of the appearance of a testicle.

UROGENITAL UNION

In a 21 millimeter embryo (7th to 8th week) the wolffian body consists of about 26 tubules situated in the lumbar region and all in a process of degeneration. This remnant of the mesonephros is divided into two portions—upper and lower. The upper or epigenital part consists of 5 to 12 tubules the blind ends of which become surrounded by the epithelial nucleus, forming in the indifferent reproductive gland so that each comes to be in a sort of bay in that part of the nucleus from which the rete testis is formed. From the beginning therefore the wolffian collecting tubules and the tubules of the testicular rete are in intimate contact and lie wall to wall. The urogenital union takes place when the two open into each other (Fig. 1) and this appears to occur at very different periods. Felix saw it first in a 60 millimeter embryo—head foot length.

When union has taken place the collecting tubules are known as the vasa efferentia. In the 4th to 5th month they begin to coil at the end nearer the wolffian duct but remain

straight toward the testis. Later, they are surrounded by a firm connective tissue membrane and become the conus vasculosi. All of the 5 to 12 tubules do not necessarily take part in the union but if not, they frequently persist as remnants in the epididymis forming the vasa aberrantia. One or two may unite before joining the rete testis.

The lower or paragenital portion of the wolffian body consists of two or three small tubules closed at both ends and persists as the paradiidymis.

FAILURE OF UNION

In a series of 42 cases in which patients with incomplete descent of the testis, were operated upon I have seen 3 in which there was no macroscopical union of the testis and epididymis. In 2 of these the absence of union was confirmed microscopically.

CASE 1 A wireless air-gunner complained of pain in the right groin since beginning to wear parachute harness. On examination the right compartment of the scrotum was empty and he stated that the testis had never been down. The right testicle could be felt in the inguinal canal and pressure over it caused the pain of which he complained. The left testicle was well down in the scrotum and it and the epididymis felt normal. No evidence of hernia was noted. October 13, 1941, under nitrous oxide gas, oxygen and ether anesthesia, pentothal induction, the right inguinal canal was opened and the testis the right lying in a patent funicular process, the fundus of which reached to the external ring. When the sac was opened the testis was seen lying on the floor about 1 inch from the internal abdominal ring (Fig. 2). The sac was freed from the floor of the inguinal canal, and the epididymis was found with the globus major almost at the fundus of the process and completely separated from the body of the testis. The vessels of the spermatic cord were very short and the testis, epididymis, and sac were removed. On microscopic examination the testis showed the usual picture of an undescended organ. The seminiferous tubules were composed of a single layer of cells, occasional spermatogonia were present but no spermatozoa. There was no microscopic connection between the body of the testis and the epididymis although there appeared to be one or two ducts leading from the upper pole of the testis. The termination of these ducts were not identified.

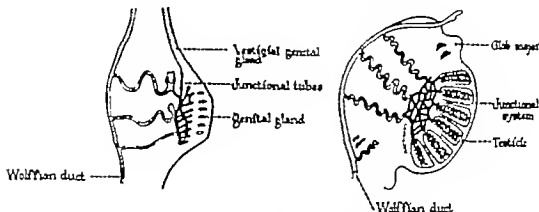


Fig. 1. A diagrammatic representation of the urogenital union. (After Keith.)

CASE 2. Attended complaining of occasional swelling, with pain in the right groin for some 12 months. The right testicle had never been in the scrotum. A small oblique right inguinal hernia reaching to the external ring was found the right testicle was not felt. The left testicle was well down in the scrotum and it and the epididymis appeared normal. On May 2, 1912 under nitrous oxide gas oxygen and ether anesthesia pentothal induction, the right inguinal canal was opened. A small patent processus vaginalis was found. The testis was intra-abdominal but the base of the mesorchium was just inside the inguinal canal (Fig. 3) and the testis could be brought into the canal. His attacks of pain may have been due to intermittent prolapse of the testis and strangulation of the cord. The vas ran down the canal on the posterior wall of the sac and terminated in a splayed-out epididymis which had no connection with the body of the testis. The vas and epididymis could be brought well down, to reach the bottom of the scrotum, without difficulty but the testis could not on account of the shortness of the vessels of the spermatic cord. The testis, epididymis and sac were removed. Microscopically the picture was similar to that in Case 1.

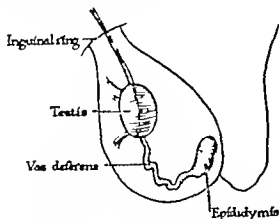


Fig. 2. Failure of descent of the right testis and failure of union with the epididymis.

CASE 3. Attended with a large left sided scrotal hernia which had gradually been increasing over a period of 10 years. The hernia was easily reducible but no testicle was felt after reduction. There was a suggestion of a thickened structure, in the posterior wall of the sac, in the empty scrotum, and a pre-operative diagnosis of atrophy of the testis was made. On December 7, 1912 under nitrous oxide gas, oxygen and ether anesthesia, pentothal induction, the left inguinal canal was opened. A large patent funicular process was found. When the sac was opened, the testis was seen lying on the floor (Fig. 4) half an inch from the inguinal ring, and bonded to the sac by adhesions. The vas passed down to the scrotum and terminated in a splayed-out epididymis. This had no macroscopic connection with the testis. The funicular process was divided proximal to the latter and cleared from the cord and epididymis. The testis was then easily mobilized and brought into the right scrotal compartment. The floor of the canal was repaired with a strip of fascia.

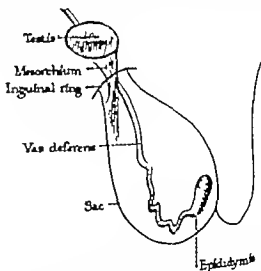


Fig. 3. An intra-abdominal right testis and failure of union with the epididymis.

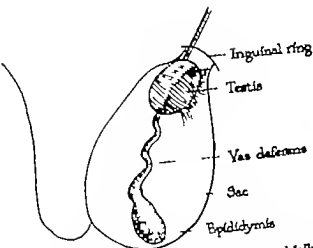


Fig. 4. Failure of descent of the left testis and failure of union with the epididymis which is well down in the scrotum. taken from the aponeurosis of the external oblique

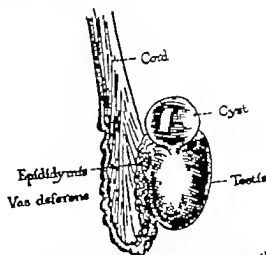


Fig. 5. A single cyst in the mediastinum testis.

These 3 cases would undoubtedly appear to illustrate failure of the urogenital union. During the past 3 years I have almost invariably included an examination of the testis on each male patient who has been referred to me. I have not observed anything which would suggest complete failure of union in a normally descended testis and it is probable that this occurs only in association with incomplete descent. However I have been struck by the comparative frequency of the occurrence in young adults, of a small cyst in the region of the mediastinum testis, and believe that not infrequently this is due to a partial failure of the urogenital union.

Ogier Ward (1922) reported 17 cases of spermatocele and described the etiology. The youngest of these patients was 41 years and the average age was 55 years. He considers it as a disease of maturity and that a spermatocele is a retention cyst of unknown pathology. Dorne (1926) reviews the literature on the subject and also considers that the condition is a retention cyst. Among the etiological factors, he mentions trauma, gonorrhoea, or any previous inflammatory process. Rolnick (1928) in the routine examination of 55,000 men for spermatocele found a clinical incidence of 1 per cent. He operated on 12 patients and found that it was possible to dissect out the cyst in only one case which was shown to have been formed from a distended tubule. He attempted to produce true spermatocele

in 28 dogs and failed in each case. McCrea (1935) gives the following classification of cysts in relation to the epididymis: (a) cystic disease of the epididymis; (b) cysts developing between the testis and the head of the epididymis; (c) cysts of vestigial structures near to or attached to the epididymis. His view is that (a) and (b) arise from obstruction but that obstruction does not necessarily result in cyst formation. He quotes Kocher and Moc-nod and Terrillon as having described dilatation of the ductuli efferentes and considers this to be the cause of or a later step in, the dilatation of the epididymis. He considers multiple cysts to be more common and more common in the epididymis than anywhere else. He also considers that (a) and (b) are retention cysts resulting from obstruction.

In the past 3 years I have seen some 12 cases of single cyst formation in the region of the mediastinum testis occurring in men under the age of 25 years. A colleague aged 43, has had one since puberty. The large majority of patients were quite unaware of any abnormality and in most cases no comment was made on it. (It is rather extraordinary how many cases of large scrotal hernia of which the patient is quite unaware are discovered at routine medical examination.) These cysts vary in size from that of a pea to a hazel nut. They give rise to no symptoms or disability and therefore the opportunity for surgical intervention—certainly in the Service—is rare. In those that have been aspirated the fluid has contained scanty spermatozoa.

I believe that these cysts form where there has been a partial failure of the urogenital union just after the commencement of spermatogenesis.

CASE 4. Presented himself with a left inguinal hernia. On examination a cystic swelling the size of a small nut was found in the region of the mediastinum of the right testis. Aged 23 he was unaware of this and therefore had no idea as to how long it had been present. At operation after the hernia had been repaired an incision was made in the right scrotum and the cyst was found lying against the epididymis, deep to the tunica vaginalis (Fig. 5). It was rather pear-shaped with the narrow or tail-end toward the testis. In the cyst fluid were scanty faintly motile spermatozoa. The cyst appeared to be a distended vas efferens.

I have noticed that occasionally after epididymectomy a cystic swelling forms in the region of the mediastinum testis. It makes its appearance within a few weeks of the operation and may grow to the size of a hazel nut. In 2 such cases in the last 18 months scanty spermatozoa were found in aspirated fluid. After aspiration the cyst refilled within a few days. It has all the characteristics of a spermatocele and has occurred when there is a complete absence of union between the testis and the collecting system.

SUMMARY AND CONCLUSION

Failure of the urogenital union has received only scanty attention in medical literature and very few cases have been described. Three cases of complete failure of union occurring in a series of 42 adults operated upon with incomplete descent of the testis are now reported. It is thought that complete failure of union occurs only in association with undescended testis. Incomplete failure of union is put forward as a suggested cause for the occurrence of single mediastinal cysts in young adults.

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PRELIMINARY REPORT OF A METHOD FOR THE PREVENTION OF LEAKAGE OF INTESTINAL ANASTOMOSES

An Experimental Study

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THE methods herein described were evolved for colon anastomoses but are applicable to all other gastrointestinal anastomoses, including small bowel anastomoses, gastroenterostomies and closure of the duodenal stump.

It was noticed both in the postmortem department and in instances in which experimental sutures had been put into redundant exteriorized colon (when it was brought out of the abdominal wall after the operation of excision of the rectum) that each particular suture hole became infected and therefore a potential source of sepsis or leak age. Thus sutured anastomosis of the colon must always have an element of risk, and although with the bringing of peritoneum to peritoneum with silk sutures which traverse only peritoneum (where this is present) the risk is minimized its dangers in any but the most experienced hands has led in many cases, to the adoption of Paul Mikulicz procedures followed by nonsuture anastomosis with a crushing clamp aseptic anastomosis techniques, and many other methods. It has been long recognized that the most important sutures are those that bring peritoneum to peritoneum and in some methods of aseptic anastomosis no attempt is made at mucosal apposition by suture. Another method of nonsuture anastomosis is the Murphy button. This method gave safe anastomoses of the small bowel with peritoneum to peritoneum junction without sutures (where the bowel is covered by peritoneum) although the button is seldom used these days. Anastomoses in parts of the bowel not completely invested by peritoneum are most difficult to accomplish successfully by any method.

The problem of suturing the large intestine can be considered to be comparable to suturing the inner tube of a motor tire. Here sutures cannot be employed to repair rents because each stitch put into the rubber tube would leak air therefore punctures in tires are mended by "vulcanizing on patches over the holes."

The method herein described involves the "vulcanizing on" of peritoneal grafts or split skin

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grafts over the suture line, whether or not the surface is covered by peritoneum. It is a procedure supplemental to the usual methods of anastomosis. It takes very little more time and there is nothing to lose if it fails.

METHOD EMPLOYED

In 1943 Sano reported a method of 'sticking' on skin grafts using dried plasma and leucocyte cream the graft was placed in contact with the recipient area without sutures. Adhesion occurred in a few minutes. In 48 hours the graft had a blood supply and was completely fixed in 4 days. Young and Favata in 1944 further simplified this procedure using thrombin solution on the unwashed skin graft, and normal pooled plasma on the recipient area. This method has been used successfully by the author in applying skin grafts cut with the dermatome, thus avoiding the necessity of suturing the graft in position and of applying pressure. Further work by Cannady (1943) had shown that strips of skin were useful in repairing a hernia and that no harm came from dermis in the tissues.

An experimental study was therefore undertaken to see whether skin or peritoneum could be grafted over the suture line of colon anastomoses on the assumption that any method which would be successful in the colon would be at least equally successful in the small bowel and stomach. The method of fibrin fixation of a graft to bowel would be physiologically sound as after all the normal formation of intra abdominal adhesions must occur by that method. Fibrin fixation of skin grafts was an established fact and had been personally found useful. However it remained to be seen whether peritoneum would 'receive' peritoneal grafts whether intracolonic pressure would 'blow off' grafts whether soiling and consequent sepsis would prevent the graft from 'taking' and whether such a convenient strong grafting material as skin or split skin could be used in the peritoneal cavity.

EXPERIMENTAL PROCEDURES

Dogs were used in the experiments because they have a strongly mobile small colon which



Fig. 1. Experiment 1. Showing most of free omental graft still sticking to the suture line.

makes surgical procedures difficult and are susceptible to general peritonitis; therefore, it followed, that they were suitable for testing the efficacy of the graft. Ten small dogs were used

TABLE I — PROTOCOL

Group A. No pressure of any kind applied.

Experiment	Type of graft	Result	State of graft	Sealing of peritoneum
	Free omental	Death 4 hrs	Half graft adherent	+++
	1/2 graft on suture line (peritoneal graft stuck well on gut)	Death 24 hrs		++++
	Peritoneum	Death 4 hrs	Adherent except at mesenteric border	++
5	Whole thickness skin	Death 30 hrs	Well adherent except at mesenteric border	+

Group B. Free peritoneal grafts held in position for about 5 minutes with pressure

	Peritoneum	Alive (killed 6th day)	Adherent	Nil
7	Peritoneum	Alive (killed 6th day)	Adherent	Nil
8	Peritoneum with hole in it	Death 7 hrs	Graft fully adherent; leak had occurred through the hole	++
	Peritoneum	Death 48 hrs	Adherent	Nil
	Peritoneum	Alive (killed 6th day)	Adherent	Nil

Group C. Exteriorized colon.

Whole thickness skin and peritoneum	Both adherent and remained adherent
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Fig. 2. Experiment 2. Showing omentum stuck to peritoneal graft which was also firmly stuck in position.

In the first 6 differing trial techniques were used, and in the succeeding 4 at a later date a more or less standardized technique was followed. In all cases the ascending colon was cut across between rubber bowel clamps to stop undue fecal contamination, and then the ends were joined together by a single continuous through-and-through silk suture which went through all bowel wall layers at once and encircled the bowel and was tied only when it came back to the place from which it started. This admittedly inadequate method of anastomosis was not assisted by the use of either a Miller Abbott tube or an artificial anus to take tension off the suture line. In some cases feces could be observed to issue from the ineffective suture line immediately after the removal of the clamps, and in the control experiment in which this suture was used alone, death occurred within 24 hours, and it was found that the abdominal cavity was full of feces. It will thus be seen that the greatest possible strain was thrown on the grafts in testing their efficacy in the prevention of leakage of intestinal contents.

RESULTS

In the first 6 experiments various procedures were used, but in only 1 case (Table I) was the graft applied with pressure. This dog lived and was killed at the end of a week, when the graft was found sticking firmly in position without any sign of leakage or peritonitis. (In the dog in which no graft of any sort was used, death occurred within 24 hours with feces being widespread throughout the peritoneal cavity.) In the remainder in which whole thickness skin, peritoneum and omental grafts were used, all were found to be firmly stuck on to the anastomosis despite the fact that pressure during application had



Fig 3 Experiment 5 Showing skin adherent to suture line

not been used but in these cases (with 'no pressure' technique) leakage had occurred at one spot or another usually at the mesenteric border

In the second series of 4 cases, peritoneal grafts only were applied with pressure for about 5 minutes. No sutures of any sort were used to fix or to hold the grafts in position in these 4 cases. 2 were alive and perfectly well at the end of 6 days, and when they were killed no peritonitis was found. In each of these cases the graft was strongly fixed in position. In one other case death occurred in 48 hours from a general hemorrhage through out the peritoneal cavity no peritonitis being present and no bowel leakage having occurred and the graft was still firmly fixed in position. The fourth died after 72 hours with general peritonitis. The graft in this dog was accidentally perforated in cutting but it was applied with the hole over the suture line just to see what would happen. This graft was stuck firmly in position and could not be pulled off the bowel but feces leaked through the hole in the graft (Fig 5).

Thus all 5 peritoneal grafts which had been applied with pressure stuck firmly in position and of these 2 dogs died 1 from hemorrhage and 1 from leakage through a hole in the peritoneal graft made while it was being taken (Fig 5). Of the 9 cases in which grafts were applied all grafts were found adherent at least in part. In the experiment in which no graft had been applied to the suture line a peritoneal graft applied to the colon elsewhere was firmly adherent.

The application of these findings to the human was first done on exteriorized redundant bowel left outside the abdominal cavity after the operation for excision of the rectum. A graft of whole thickness skin and a graft of peritoneum were both taken at the time of operation and refrigerated for 6 hours before application to the exteriorized



Fig 4 Experiment 7 Showing peritoneal graft stuck firmly in position.

colon on its peritoneal aspect, plasma being applied to the bowel and a few drops of thrombin solution to the graft. Pressure was applied for 4 minutes and the graft adhered readily. They were firmly fixed in 24 hours and by the third day appeared to have a blood supply and by the fourth day the edges could not be lifted. The fixation was easier than with dog plasma because human plasma is much more sticky than dog plasma and of course human bowel and skin and peritoneum are much larger and easier to handle than are the filmy dog peritoneum and small dog colon which had presented many technical difficulties in the spreading of the graft.



Fig 5 Experiment 8 Showing edematous peritoneal graft stuck firmly in position with arrow pointing to hole in the graft through which soiling of the peritoneal cavity had occurred.



Fig. 6. Experiment 6. Showing mass of omentum adhering to peritoneal graft which was firmly fixed in position.

Observation of the grafts in the dogs and man shows that they adhere with a reasonable tenacity immediately that by 48 hours they are quite firmly adherent and that at the end of a week they could not be pulled off. After 48 hours the grafts appeared to be edematous and to stay so for some days.

It is reasonable to suggest, therefore, that the employment of these grafts in intestinal anastomoses in man will be of great value and may obviate the use of staged operations now commonly performed in order to avoid the risk of leakage from the suture line.

PROTOCOL OF EXPERIMENTS

In all cases a right upper paramedian abdominal incision was made and the ascending colon cut across about 4 inches from the cecum. The ends were then joined together with a continuous silk

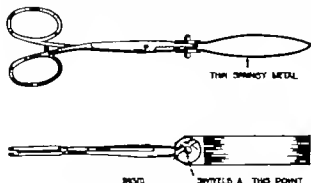


Fig. 8. Clamps used by author.



Fig. 7. Human. Peritoneal and skin grafts applied to exteriorized human bow. 1. A points to the skin and B to the peritoneum. (Photograph taken on fourth day.)

suture starting on the mesenteric border and traversing all coats and being tied again on return to the mesenteric border. Chloroform anesthesia was used throughout. The first 6 experiments were done on August 26, 1945 and the second 4 on September 7, 1945. Small dogs were used.

Graft A

Experiment 1. A free graft cut from the greater omentum was swabbed with a large amount of thrombi solution made by dissolving 5000 units of 5 cubic centimeters of saline. The suture line was flushed with dog plasma (collected) taken from a single dog 5 days before. The graft was laid over the bowel and a few sutures of silk fixed it to the bowel. Death occurred in about 24 hours with generalized peritonitis, and only half of the graft was found to be still adherent to the suture line.

Experiment 2. A strip from the anterior peritoneum about half an inch wide was wrapped round the bowel and moistened with little thrombi solution and the suture line was swabbed with plasma. The strip was held in position over the suture line by a firm metal clamp which compressed the bowel so that it became flat. The clamp was removed after 5 minutes, and the graft as found to be well stuck to the flat bowel. Time of death—this dog, as all, and well and was killed by chloroform on the next day when no peritonitis was found, and the graft could not be pulled off. Omentum had also stuck to one side of the neighborhood of the anastomosis.

Experiment 3. A graft of thrombi as used in postage-stamp size of peritoneum was cut and applied to the cecum after having been swabbed with thrombi and the cecum with plasma. It stuck on well and as found to be still stuck on after death. Time of death—at 24 hours. At postmortem the peritoneal cavity was found to be free of feces.

Experiment 4. A strip of anterior peritoneum about half an inch wide was banded around the anastomosis. The graft was first dried and then just moistened with thrombi. Plenty of plasma was put on the bowel itself, but no

pressure was applied. *Time of death*—at about 18 hours. A generalized peritonitic reaction and soiling of the peritoneal cavity were present, and there was a leakage from the mesenteric border where the graft was not stuck on. For the remaining circumference of the bowel the graft was firmly stuck on.

Experiment 5. A strip of whole thickness skin about half an inch wide was moistened with a few drops of thrombin and applied like a bandage round the bowel. The ends did not meet very nicely round the mesenteric border. No pressure was applied. A patch of submucosa was moistened with thrombin and applied to the bowel on the line of the anastomosis had been put about an inch from the line of the anastomosis. *Time of death*—at about 36 hours. At postmortem there was a slight peritonitis present. The graft had stuck on well but there was a leak at the mesenteric border. The submucosal graft was well adherent to the bowel.

Experiment 6. A free omental graft about 3 inches by an inch was dried and a small amount of thrombin solution applied and then it was wrapped around the bowel on the site of the anastomosis—no pressure being applied. *Time of death*—at about 24 hours. Some of the graft had not adhered. No definite leakage could be found.

Group B

Experiment 7. A graft of peritoneum plus muscle about three-quarters of an inch wide and an inch and a half long was swabbed with 3 or 4 drops of thrombin solution on its peritoneal side which was then applied to the line of anastomosis which had been swabbed with plasma. The graft was pressed into position by two clamps for 5 minutes. *Time of death*—this was pressed into position by two clamps for 5 minutes. The animal was frisky and well on the sixth day when it was killed. *Postmortem report*—a wound abscess was present, but there was no peritonitis and the graft had stuck on well and surrounding small bowel had also adhered to one side of the graft.

Experiment 8. A strip of peritoneum half an inch wide and 3 inches long which had a hole in the middle of it (made on taking it from the abdominal wall) was applied to the bowel on which plasma had been swabbed after having been moistened with 3 or 4 drops of thrombin solution. It was held in position with two clamps and on removing the clamps after 5 minutes the graft had stuck on well to the flattened bowel. *Time of death*—about 72 hours. *Postmortem report*—there was a general peritonitis present. The graft had still stuck firmly in position and could not be pulled off but through the hole in the center of the graft feces had contaminated the peritoneal cavity.

Experiment 9. A strip of peritoneum half an inch wide and 3 inches long was moistened with thrombin and held over the suture line with a pressure clamp for 5 minutes. *Time of death*—48 hours. *Postmortem report*—a very extensive hemorrhage into the peritoneal cavity but with no soiling or peritonitis, and the graft was still firmly in position with no leakage apparent.

Experiment 10. A three-quarter inch by 1 inch strip of anterior peritoneum was wrapped around the bowel two and a half times after having been moistened with plasma, and the bowel having been swabbed with plasma, it was clamped on for 5 minutes with a pressure clamp, and then thrombin solution was swabbed on it stuck on well. Then thrombin and plasma was put over the some of the greater omentum and graft and on the graft. The omentum was wrapped loosely round the anastomosis area. *Time of death*—dog was very well and frisky and was killed on the sixth day. *Postmortem report*—no

peritonitis was present and the omentum was wrapped irremovably around the grafted bowel and the graft was also firmly fixed in position.

The possible human applications of these findings on dogs and the human bowel are that with the usual methods of anastomosis as used in either gastroenterostomy operations on the esophagus, gastrorectomy closure of the duodenal stump and small or large bowel anastomoses, the suture line can be very rapidly reinforced by a strip of anterior peritoneum sufficient to go round the bowel and with a little to spare and about three-quarters to an inch in width. This would be moistened with a few drops of a solution of 5000 units of thrombin in 5 cubic centimeters of saline and applied to the suture line which has been swabbed with pooled human plasma, most conveniently obtained from a blood bank. Both these solutions keep a long while in the refrigerator and indefinitely in the desiccated form. This procedure could be done whether or not there is peritoneum on the suture line. Pressure would then be applied for 5 minutes by medium of some such type of clamp as used by the author (Fig. 8) and then the intestines would be carefully returned to the abdominal cavity if handled roughly in its early stages, the graft may be rubbed off before becoming firm. As a further precaution and where anatomically possible omentum could be moistened with thrombin and applied to graft and bowel which has been painted with plasma. This will then adhere and form artificial adhesions as was shown in experiments 10 and 2. Thus a rapid and easy means of omental reinforcement of suture lines is available. Further for some time it has been the practice of the author before suturing to moisten with thrombin solution one side of intestines being anastomosed and the other side with plasma solution. Thus the normal sealing and repair of bowel are speeded up during the few important hours when the bowel is quiescent following laparotomy.

SUMMARY AND CONCLUSIONS

The theoretical basis of a quick, easy method of increasing the safety and scope of a gastrointestinal tract anastomosis is described. Experimental results in dogs and application in a human being are brought forward in support of this method.

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UTILIZATION OF HENLE'S LIGAMENT ILIOPUBIC TRACT APONEUROSIS TRANSVERSUS ABDOMINIS AND COOPER'S LIGAMENT IN INGUINAL HERNIORRHAPHY

A Report of 162 Consecutive Cases

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IN November of 1943 because of the urgent need for replacements in the Army it was decided to induct those men who previously had been deferred because of inguinal hernias. The Station Hospital, Fort Douglas, Utah was called upon to rehabilitate many of these men as it is adjacent to a reception center and it seemed advisable to keep them near home until they could undertake basic training.

To plan an operative technique that would make recurrence under the strain of training and combat less likely we decided to review available hospital operative records on recurrent hernias to determine the point at which they had broken through the abdominal wall. It was found that 75 per cent had occurred as direct hernias superior to the pubic tubercle, and posterior to the external abdominal inguinal ring (Fig. 3). The remainder had occurred as indirect hernias probably from incomplete obliteration of the sac.

Many of the standard methods of repair of inguinal hernias have employed the principle of suturing the conjoint tendon to the inguinal ligament to reinforce the posterior wall of the inguinal canal. Surprisingly little attention has been paid to the utilization of other tough tissues that exist in this area, namely the strengthening fibers in the transversalis fascia.

McVay and Anson have recently called attention to the anatomy of the inguinal region and have reanalyzed the structures in that area. They have found considerable variation between their careful dissections and the descriptions ordinarily occurring in standard textbooks, particularly with reference to the transversalis fascia and the conjoint tendon.

TRANSVERSALIS FASCIA

Most texts inadequately describe the transversalis fascia as a structure lining the inner sur-

face of the abdominal musculature (Fig. 3). In our dissections of the inguinal area we found that the transversalis fascia consists of three prominent fibrous structures with intervening connective tissue. These three fibrous reinforcements of the transversalis fascia are the iliopubic tract, Henle's ligament, and the aponeurosis of the transversus abdominis. For a more detailed description of the anatomy the work of McVay and Anson should be consulted.

Iliopubic tract. The transversalis fascia is directly continued into the thigh as a part of the femoral sheath. When this fascia is dissected from the inguinal ligament, care being taken not to open the fascia, there is a band of fibers paralleling the inguinal ligament and demarcating the abdominal component of the fascia from that of the thigh. It can be palpated as a tough, fibrous structure posterior to and separate from the inguinal ligament and cannot be seen unless it is separated from that ligament (Fig. 4). The tract is best seen anatomically by severing and retracting the inguinal ligament (Fig. 5). It is of considerable strength, passes inferior to the internal abdominal inguinal ring and may be traced from the iliopectineus (pectus) fascia in the area of the anterior inferior iliac spine to the pubic tubercle (Figs. 2, 3). Medially blending with Henle's ligament, the aponeurosis of the transversus abdominis and other less prominent portions of the transversalis fascia, the fibers of this tract insert into the pubic tubercle and Cooper's ligament (Figs. 5, 6). This band of fibers of the transversalis fascia, the iliopubic tract, has always been present and was easily identified. It is a separate structure from the inguinal ligament.

Henle's ligament. Without entering into any historical controversy concerning Henle's ligament (McVay *et al.*) we found in all of our dissections a definite fibrous structure, which seemed to be derived in part from the lowermost portion of the lateral border of the rectus sheath, and in

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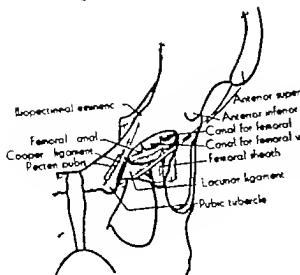


Fig 1

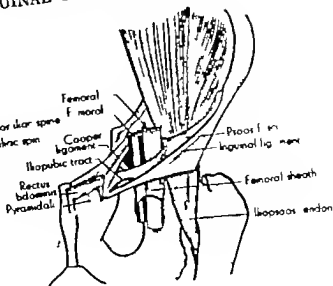


Fig 2

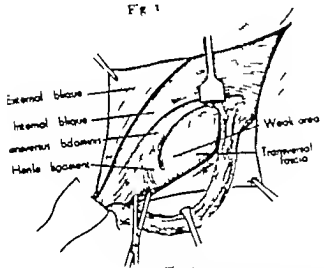


Fig 3

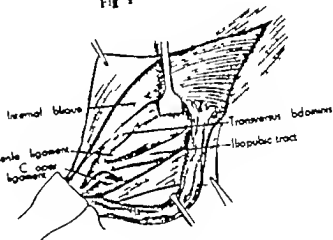


Fig 4

part from the lowermost extent of the aponeurosis of the transversus abdominis (Fig 3). Fanning out inferolaterally it intermingled intimately with the fibers of the iliopubic tract (Fig 5). This is the structure originally described by Henle.

Aponeurosis of the transversus abdominis The lowermost fibers of insertion of the transversus abdominis muscle are aponeurotic and appear as a flat band paralleling the lateral border of the rectus sheath (Figs 3, 5). Superiorly some of the fibers pass anterior to the rectus abdominis muscle and form part of the anterior wall of the rectus sheath while inferiorly some pass down to blend with Henle's ligament. The major portion of these fibers, however insert into the pecten of the pubis (Fig 6).

CONJOINED TENDON

In our experience both in the dissecting room and the operating room wide variations in the

structure and appearance of the conjoined tendon have been noted. The normal anatomy of the conjoined tendon as described in textbooks, was frequently observed although often it was difficult to differentiate the conjoined tendon from the lateral border of the rectus sheath. Classically the conjoined tendon is described as a common tendon of those fibers of the internal oblique and transversus abdominis muscles which form an arch over the spermatic cord (round ligament in the female) and insert into the pubic tubercle and the pecten of the pubis. More careful analysis of our dissections show that this so-called tendon is composed of two sheets of tissue representing those portions of the aponeurosis of insertion of the internal oblique and transversus abdominis muscles lying anterior and in small part lateral to the rectus abdominis muscle insertion. These two aponeuroses are not a fused tendon as usually described but two distinctly separable aponeuroses.

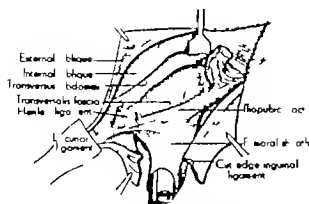


Fig. 5

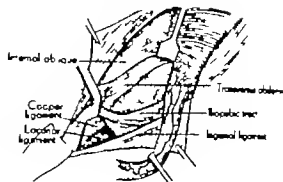


Fig. 6

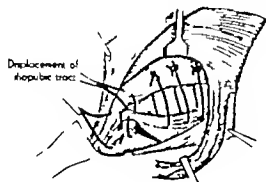


Fig. 7

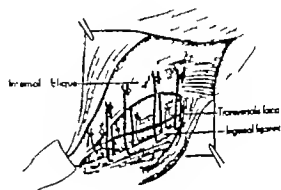


Fig. 8

Some of our past difficulties in explaining the conjoined tendon to ourselves and to the discerning student lay in the fact that the aponeurotic insertion of the internal oblique failed to reach the pubic tubercle or the pecten of the pubis, but inserted into the anterior rectus sheath interdigitating with fibers of its fellow several centimeters above the usual point of insertion. Moreover in some dissections it was found that the aponeurotic insertion of the transversus abdominis was into the lateral wall of the rectus sheath as described by Robins. These abnormal insertions of the internal oblique and transversus abdominis muscles leave a weakened area superior to the pubic tubercle and posterior to the external abdominal inguinal ring (Fig. 3) the site of most recurrent hernias (Babcock, and Robins). The only structure present in many of these dissections reinforcing this area was a weakened transversalis fascia.

COOPER'S LIGAMENT

In addition to the structures described another important ligament exists, which extends from the pubic tubercle along the pecten of the pubis

and continues posteriorly along the iliopectineal line at an angle of approximately 30 degrees to the inguinal ligament (Figs. 1 & 2). It disappears near the iliopectineal eminence by blending with the periosteum of the bone, and is intimately adherent to the bone in its entire extent. Because of its strength and position it would seem only logical that it must have considerable importance. To it are attached from below upward the pectineal fascia, the lacunar ligament, the aponeurotic thickening of the transversus abdominis, Heale's ligament and the remaining less distinct portions of the transversalis fascia (Figs. 5, 6).

Harkins and Swenson have reviewed the literature and pointed out that the suturing of the transversalis fascia and attached structures to Cooper's ligament was not new. Such men as Narath (1898), Lotheisen (1898), Fischer (1919), Groves (1923), Stetten (1923), Andrews (1924), Keynes (1927), Babcock (1927), Dickson (1936), McVay and Anson (1938-42), Gohard (1939), McClure and Fallis (1939), Amendola (1941), Neubof (1942) and Harkins *et al.* (1943) have used this structure, and been satisfied with its importance in the repair of hernias of this region.

THE REPAIR

The technique presented herein has been developed and tested on 162 inguinal hernias of all types. To date there have been no recurrences. At the time this work was started we were not aware of McVay's operation.

Unless contraindicated all of our herniorrhaphies are done under spinal anesthesia. Regardless of the type of hernia to be repaired a skin incision is made as originally described by Bassini clamping the superficial vessels before they are severed. The aponeurosis of the external oblique is cleaned of all fat and areolar tissue by sharp dissection, and a small incision is made in the direction of the fibers of the external oblique, near the upper margin of the wound. The incision is carefully enlarged with scissors until the ilio-inguinal nerve is exposed and dissected free, and the iliohypogastric nerve is identified. (Damage to these nerves may result in an annoying skin anesthesia and a loss of tone of the internal oblique and transversus abdominis muscles favoring a recurrence of the hernia.)

The incision is then extended down through the external ring and with a moist gauze sponge, the aponeurosis is cleaned down to its insertion. The pubic tubercle is clearly identified and all areolar tissue is cleaned from it with a sponge. The sheath of the cremaster muscle is not opened but is detached from the inguinal ligament with a moist sponge. After the cord has been mobilized, it is held with an Allis forcep if small or with a rubber tape if large enough to be constricted by an Allis.

The indirect sac is identified and picked up at the anteromedial surface of the cord. It is incised and freed from the surrounding structures by sharp and blunt dissection. Exploration is carried out through the incision in the indirect sac for a direct sac, and if one is found it is transposed lateral to the epigastric vessels, converting both sacs into one (Hoguet). It is necessary to identify the inferior epigastric vessels and to separate some preperitoneal fat from the indirect sac and to visualize and dissect the bladder away from a large direct sac before dissection of the sac is complete. Failure to do so may result in a recurrence of the hernia. The sac is closed with a pursestring suture and usually transfixed under the transversalis fascia and internal oblique muscle although this step may not be necessary if the sac dissection is complete.

In order to avoid subsequent confusion in the identification of the structures used in the repair the internal abdominal oblique muscle is identified and held with an Allis forcep. This step

avoids later inadvertent suture of the muscle and its aponeurosis to the deeper structures.

Next Cooper's ligament is palpated as a tough, ridge-like band extending from the pubic tubercle along the iliopectineal line (Figs. 1, 2). The transversalis fascia is then separated from the inguinal ligament and the underlying lacunar ligament in the area adjacent to the pubic tubercle by means of a small straight forceps (Fig. 3) and the anterior 2 centimeters of Cooper's ligament exposed (Fig. 4). Unless this separation is carried out close to the pubic tubercle the transversalis fascia will be entered and preperitoneal fat encountered, so as to interfere with subsequent suture (Trowbridge).

Further digital separation of the transversalis fascia from the inguinal ligament exposes a tough fibrous structure the iliopectineal tract and the underlying femoral sheath (Figs. 4, 5, 6). By clearly exposing the iliopectineal tract and mobilizing the femoral sheath a procedure not previously described in the literature, we avoid accidental injury to the femoral vein or artery (Figs. 2, 5).

Galile transplants of fascia lata, obtained with a Mason fascia stripper are preferred to any other suture material for recurrent direct and scrotal indirect hernias. When fascia lata is used the first strip (1 centimeter wide and 15 to 20 centimeters long) is anchored into the peritoneum and tough structures overlying the pubic tubercle (Fig. 7). From this point a continuous running fascial suture is used. Henle's ligament is then brought down to Cooper's ligament. Next the Galile needle is passed successively through Henle's ligament, Cooper's ligament and the medial portion of the iliopectineal tract closing the weakened area in the transversalis fascia, the site of most recurrent hernias. At the same time, the iliopectineal tract is displaced, shortened and drawn diagonally across the area occupied by the femoral canal, to close the canal (Figs. 1, 2, 3, 7). This procedure is technically less difficult than suturing the aponeurosis of the transversus abdominis in Cooper's ligament in the relatively inaccessible region of the femoral vein (McVay 1942) and permits clear visualization of all structures used in the repair. The suture is continued (Fig. 7) attaching the lowermost margin of the aponeurosis of the transversus abdominis to the iliopectineal tract, folding under and obliterating the relatively weaker areas of the transversalis fascia. When the internal abdominal inguinal ring is reached it may be closed tightly without encircling the dangerous circulation of the cord. The end of the fascial strip is then anchored with interrupted No. 40 cotton sutures.

The same technique is employed in less difficult repairs with interrupted No. 30 cotton sutures.

This repair of the transversalis fascia and its reinforcing structures produces a strong barrier to recurrence of hernias. While there may be no necessity for further repair of overlying structures (McVay *et al.*) on the other hand, in most cases it is a very simple procedure to suture the lowermost margin of the internal abdominal oblique muscle and its aponeurosis to the inguinal ligament, by means of a fascial strip or interrupted No. 30 cotton sutures, after the method of Bassini (Fig. 8). We do not hesitate to use muscle for this second layer when the aponeurosis is deficient. Dissections of recurrent hernias have convinced us that the epimysium of the muscle will become firmly adherent to the inguinal ligament. Occasionally it is found that the anomalous aponeurotic insertion of the internal abdominal oblique muscle cannot be easily approximated to the inguinal ligament. In that event a relaxing incision in the rectus sheath is made (Rienhoff) and the fascia overlying the pyramidalis muscle, the lateral border of the rectus sheath and available fibers of the internal abdominal oblique and its aponeurosis are then sutured to the shelving margin of the inguinal ligament. Either method of suture produces an additional strong barrier and although we feel that the second layer is the least important of the two nevertheless, the Bassini operation has cured many thousands of cases. Therefore, we have used this additional precaution.

The aponeurosis of the external oblique is repaired loosely over the spermatic cord, and the external inguinal ring is not made unduly small. We do not believe that the aponeurosis of the external oblique can be of much significance as a barrier to recurrent hernias, once the posterior wall of the inguinal canal has broken down.

SUMMARY

With certain anatomical facts as a basis for a rational reconstruction of an inguinal hernia, the described operation was devised. It completely closes the weak area superior to the pubic tubercle and posterior to the external abdominal inguinal ring. The salient features are

1. By separating the loosely attached transversalis fascia from the inguinal and lacunar ligaments at their most inferior portion (close to the pubic tubercle) and stripping the fascia from the ligaments, a strong band of fibers is exposed the iliopectic tract (Figs. 3, 4, 6)

2. As an initial step Henle's Ligament and adjacent portions of the aponeurosis of the transversus abdominis are sutured to Cooper's Ligament along its anterior one-third, an available surface of approximately 2 centimeters. This results in no undue tension, whereas, suturing these structures to the entire length of the ligament, namely back to the area of the femoral vein, does result in a definite tension and requires a relaxing incision in the rectus sheath.

3. The weak area of the transversalis fascia is further strengthened by attaching the transversus abdominis aponeurosis to the iliopectic tract as far as the internal abdominal inguinal ring (Fig. 7). This produces a strong pleat of transversalis fascia and raises and displaces the iliopectic tract closing the former defect (Fig. 7). At the same time this step produces a tight internal abdominal ring and closes the femoral canal.

4. A second barrier may be constructed by suturing the aponeurotic lower fibers of the internal oblique muscle to the inguinal ligament after the method of Bassini. If this aponeurosis should be deficient, a suture in the rectus sheath or in the aponeurosis of the transversus abdominis is taken, medial to that described in paragraph 3, and this layer sutured to the inguinal ligament. Rarely a relaxing incision in the rectus sheath required.

5. The aponeurosis of the external oblique is repaired loosely over the spermatic cord, and the external abdominal inguinal ring is not made unduly small.

6. Strips of fascia lata have been found to be the most suitable suture material for the repair of recurrent, direct, and large scrotal indirect hernias.

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EARLY POSTOPERATIVE RISING

A Statistical Study of Hospital Complications

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THERE has recently been a revival of interest in early postoperative rising and walking. In June 1942 a critical study of early postoperative ambulation was undertaken at the Peter Bent Brigham Hospital. The preliminary results of these studies are the basis for this communication.

Ries in 1899 was the first to report on the subject of early postoperative rising. He had noted that his gynecological patients who rose from bed shortly after operation were considerably stronger than as a group they had a low incidence of post operative complications and that there were no demonstrable ill effects of early rising. The early rising technique was not then widely accepted in this country but in continental Europe it has been extensively used from 1909 until the present time. The recent revival of American interest in this subject began in 1941 when Leithauer (4) reported a series of 436 cases. Newburger (5) has published an excellent review of the American and foreign literature on the subject and also experimental data of his own (6) from rats. Newburger's experiments showed increased strength in wounds of animals in the early postoperative period if they had been given postoperative exercise. Clinical papers have been published by Leithauer (3) Nelson Nixon Powers, D'Ingianni, and Schafer and Dragstedt. All these authors are impressed by the rapid return to full strength of their early rising postoperative patients and by the apparent early reduction of wound discomfort. Almost all of them note a low incidence of pulmonary complications and of deep phlebitis of the legs. The latter three reports are the only ones in which any comparisons are drawn between a series of early rising patients and a control series. The definition of what constitutes early rising has not been very strict as some authors include in this group patients who have risen as late as the 4th or 5th day after operation.

In order to arrive at an accurate appraisal of the results of early rising cases must be compared under as similar circumstances as possible. Since the incidence of pulmonary and vascular complications appears to vary in different parts of the

country the results of an early rising series in one region cannot properly be compared with those of a control series from a different region. The two series are most accurately comparable if they are observed in the same clinic.

METHOD

In order to emphasize any apparent changes in postoperative complications this study is limited to the type of operative case in which the complications most commonly occur that is, patients having major abdominal surgery. Only patients who rose from bed either on the first or second postoperative day are considered in the group of early risers. These are compared with patients who remained in bed at least 1 week after operation.

This study compares 238 consecutive cases in which early rising was practiced with 443 in which it was not. The factors considered as possibly bearing on the incidence of complications were (1) age, (2) sex (3) type of anesthesia, (4) type of incision (upper vertical lower vertical and McBurney).

The operations performed through upper abdominal incisions were on the biliary tract stomach duodenum and spleen. The operations through lower incisions were on the small and large bowel female internal genitalia, and occasionally the appendix. The procedures through McBurney incisions were all appendicectomies. The suture technique was that of interrupted fine silk to all layers except the peritoneum where continuous chromic catgut was used.

The complications studied were (1) pulmonary (atelectasis, pneumonia) (2) vascular (phlebitis, pulmonary infarct) (3) wound (disruption, infection).

Our technique of getting the patients up from bed is modeled after Leithauer (4). The patient is turned upon the side on which he has his incision. The hips and knees are flexed. Thus the knees and lower legs are brought to the edge of the bed. The patient is then raised sideways to a sitting position on the side of the bed. The advantage of sitting up in this manner is that as the patient assists in raising himself he uses the flank muscles on the side opposite from his wound. As the patient sits on the side of the bed his shoes are

TABLE I—ANALYSIS OF COMPLICATIONS IN EARLY AND NON-EARLY RISING PATIENTS

	First day rising		Second day rising		Non-early rising	
	No.	Per cent	No.	Per cent	No.	Per cent
Total patients	181		53		445	
Complications						
Pulmonary	9	4.9	4	7.5	35	7.9
Atelectasis	8	3	3	5.7	26	6.1
Pleuritis	1	3		8	8	1
Infarct	2	0				
Fatal infarct		34				
Wound disruption				8		3
Wound infection	6	7			25	5.1
Postemacole		34		8	7	6
Med		34		8	10	1
Postoperative day of discharge						
7th-eighth day	61	33	5	16	64	13.7
10-12th day	37	21	16	30	76	13.8
14th-16th day	30	16	13	24.6	143	20.1
17th day plus	33	9	9	17	180	20.2

put on and then he stands up on a foot stool¹ While standing on the foot stool, he is encouraged to breathe deeply and to cough several times after deep inspiration. This procedure is less painful than when the patient coughs in bed and is often effective in raising mucous plugs from the bronchi. He is now encouraged to walk 8 or 10 feet before sitting in a chair. On the first rising the patient remains in the chair about 10 minutes, and then returns to bed in the same manner as he rose. Our patients were gotten up twice each day. Usually by the third or fourth day they needed little or no assistance and could rise at will. All the patients were encouraged to move freely about in bed and to breathe deeply several times each hour.

RESULTS

The most striking effect observed in early rising patients is the rapidity with which they regain their strength. In point of fact, they do not seem to lose strength. They are more active in bed, and their wounds are less disabling. On the fourth postoperative day most of the early rising patients had very little wound discomfort and got up unassisted. At this time they became ambulatory patients and required very little nursing care. As a result of this early strength and freedom from pain, most of the patients requested that they go

home earlier than the non-early rising patients. We did not feel justified in sending our patients home before the seventh to ninth postoperative day because not until then could we consider that the time for appearance of wound infection or disruption had passed. In spite of this, 64 per cent of the early rising patients were discharged before the 13th postoperative day while only 26 per cent of the control group were discharged by this time. At the time of discharge, those of the early rising group were strong and able to do a great deal for themselves in contrast to the group who had remained in bed for 10 to 14 days and were usually discharged 1 or 2 days after getting out of bed.

INCIDENCE OF COMPLICATIONS

Table I lists the overall incidence of complications. The complications in the patients who rose on the second day are separated from those who rose on the first day so that a more accurate picture will be given. As this study was begun, we were concerned lest there be a marked increase in the incidence of wound disruption among the early rising group. It is seen that instead of increased incidence of wound disruption, the early rising group had a slightly lower incidence of wound disruption. Likewise the incidence of pulmonary complications was reduced. The incidence of vascular complications, however, was somewhat increased. None of these increments are, as yet, significantly greater than the standard error of the difference but they point the trend. The trend

¹ We have considered it important to put on the patient's shoes, or slippers with heels, before he leaves the foot stool. Properly laced against deep relaxation of the leg veins. If the patient is one with short leg cords, he might injure his posterior calf muscles by standing, stepping down from the foot stool, or walking, and a pathological sequence could be initiated that might result in deep phlebitis.

TABLE II.—ANALYSIS OF PULMONARY COMPLICATIONS

	First day rising						Non-early rising					
	Number	Pneumonia		Atelectasis		Total	Number	Pneumonia		Atelectasis		Total
		No.	Per cent	No.	Per cent			No.	Per cent	No.	Per cent	
Incisions (abdominal)												
Upper	84			3	0.3	0	68	3	3	30		3
Lower	45						54			7	5	7
McBurney	50						91					3
Sex												
Female	6			2	3	7	30		7	3	4.3	5
Male	67					3	14	5	3.5	5	11	20
Anesthesia												
Ether	123			7	5.6	7	408	6	5	26	4.4	5
Spinal	30					1	0					1
Total	10						4		7			7
Age												
2-30 yrs.	63						3	4	3	7	5.0	6.5
31-60 yrs.	28			3	10.7	6	6.6	3		8	13	18.6
60 yrs. plus	34			2	5.8	3	8.8	3	0	10		8

toward earlier discharge from the hospital is seen in the greater percentage of the test group who were discharged early. This reduction in hospital days required and the fact that the patients who have risen early need less care represents a definite reduction in work for the ward personnel.

Pulmonary complications. The diagnosis of atelectasis was made in our patients on a clinical basis if there was a postoperative rise in temperature associated with rales and elevated respiratory rate in the absence of other demonstrable cause for fever. The diagnosis was also made if there was x ray evidence of atelectasis. The incidence in the first day rising group was 4.3 per cent, 6.3 per cent in the late rising group.

Table II is a comparative chart of the pulmonary complications analyzed for their various etiological factors. The familiar greater incidence of atelectasis in upper abdominal vertical wounds is seen in both groups when the cases are divided with respect to the location of the abdominal wound. It is significant that no case of atelectasis occurred in the cases with low abdominal wounds who rose on the first day.

Analysis for the sex factor shows that although the incidence of atelectasis in men who remained in bed was high it was unusually low in those who rose on the first day after operation. The incidence of atelectasis among the females of the two groups is essentially the same.

The analysis for the type of anesthesia shows no significant variation in the incidence of atelectasis

in either group whether ether or spinal anesthesia was used.

The influence of the age factor repeats the familiar pattern of increasing incidence of atelectasis with advancing age in both groups.

Pneumonia was such an infrequent complication that it does not permit comparative analysis.

Vascular complications. The term phlebitis is used in this discussion to include both silent thrombosis (phlebothrombosis) and deep phlebitis of the legs. The diagnosis of deep leg vein phlebitis was made on the basis of tenderness in the calf muscles, associated usually with one or more other signs i.e. a positive dorsiflexion (Homans') sign, edema of the lower leg, or a rise in pulse rate, temperature, or white count. Also if a patient had pulmonary infarct or embolism in the absence of heart disease, a presumptive diagnosis of phlebitis was made. The overall incidence of deep vein phlebitis among the early rising patients is seen to be greater than among those who did not rise early (3.2 per cent vs. 1.8 per cent). See Table III.

Analysis of the incidence of phlebitis with respect to the placement of wounds shows that there was no phlebitis recorded in any of the McBurney incisions whether they rose early or not. The females had a higher incidence of phlebitis than the males in the first day rising group. The highest incidence of phlebitis in the non rising group was in the patients of 60 years or more, but in the early rising patients, the highest incidence was in the group between 30 and 60 years.

TABLE III.—ANALYSIS OF VASCULAR COMPLICATIONS

	First day rising					Non-early rising				
	Number	Phlebitis		Infarct		Number	Phlebitis		Infarct	
		No.	Per cent	No.	Per cent		No.	Per cent	No.	Per cent
Incisions (abdominal)										
Upper	24	4	4.2		.4	298	3	3		1
Lower	45		4.4			54	3	9		6
McBurney	36					91				
Sex										
Female	3	6	3	3	3	308	4	3		1
Male	67					243	4	5		7
Anesthesia										
Ether	113	3	3.3	3	.3	408	6			1
Spiral	39		4			19				
Local	28					24				
Age										
1-20 yrs.	63		4		4	195				
21-40 yrs.	23	2	2.7		2	123		4		
41 yrs. plus	34					86	7	3		1

This observed increase in the incidence of post operative deep phlebitis of the legs is not great enough to be of irrefutable statistical significance. But it is significant that our data do not agree with many of the previously published clinical impressions that early rising produces a reduction in the incidence of phlebitis. Early rising is apparently not the answer to the problem of postoperative venous thrombosis.

WOUND COMPLICATIONS

Considerable interest was attached to the possibility of increase in wound disruption which might occur from the increased stress put upon the wound in rising from the bed and walking about. Wound disruption is here defined as any wound in which the fascia is shown to have separated whether or not the peritoneum remained intact. Our data (Table IV) show an actual reduction

TABLE IV.—ANALYSIS OF WOUND COMPLICATIONS

	First day rising					Non-early rising				
	Number	Wound Infection		Wound Disruption		Number	Wound Infection		Wound Disruption	
		No.	Per cent	No.	Per cent		No.	Per cent	No.	Per cent
Incisions (abdominal)										
Upper	24		5		.4	298		5.6	6	
Lower	45					54		3		3
McBurney	36		6			91	19			
Sex										
Female	13	4	4		2	301	14	6	3	
Male	67		5		5	243	11	7.6	9	6.1
Anesthesia										
Ether	113	4	3		7	408	23	6	13	9
Spiral	39		6		6	9				
Local	28					24				
Age										
1-20 yrs.	63					1	30	6	3	
21-40 yrs.	23	4	2			133	13	1.6	7	3
41 yrs. plus	34		9		9	86		3		1

wound disruption in the test group. Among early rising patients there was 1.1 per cent of wound disruption whereas in the non-rising patients, there was 2.8 per cent incidence of wound disruption. The known higher incidence of wound disruption in upper abdominal incisions was demonstrated in both series. The two McBurney incisions that had wound disruption were those in which drains had been used.

The incidence of wound infection among the early rising patients was 2.7 per cent as compared with 5.7 per cent in the patients who rose late. This group includes all types of infection including stitch abscesses.

It is interesting to note that all of the wound infections in both series appeared in patients with potentially contaminated wounds. Of the 5 patients who had infected wounds in the early rising group there were 4 patients who had cholecystectomies and 1 patient who had an appendectomy for acute appendicitis. Of the 25 patients who had infected wounds in the non-early rising group 11 had appendectomies, 10 cholecystectomies, 1 a perforated ulcer and 3 a resection of the large bowel.

EVALUATION

We have now observed the technique of early postoperative rising for 3 years. Data on a control series of intra-abdominal operations are presented herewith. The most remarkable observation is that postoperative activity tends to maintain the patient's strength and endurance whereas prolonged rest leads to increasing weakness and muscle atrophy. It also appears that muscle activity in the region of the wound has the tendency to reduce the period of wound tenderness but it does not increase the incidence of wound disruption.

Early rising appears to reduce the incidence of postoperative atelectasis. This may be due to increased respiration and more effective coughing, especially when the patient is standing when his diaphragm can descend to lower levels (3). Since atelectasis most frequently appears during the first 48 hours after operation, the patient should be gotten up as soon as possible within that period if rising is to have a significant effect on preventing atelectasis.

In our experience¹ the incidence of phlebitis or phlebotrombosis of the deep veins in the legs is not reduced by early postoperative walking. Our data agree with the published impression of D'Inganni who observed early rising patients in New Orleans. There may be certain precautions which can be observed to minimize calf muscle trauma when patients rise from bed. These are however equally important at any time in the postoperative period.

There was no greater incidence of wound disruption and infection in our patients who rose early.

SUMMARY

A controlled, preliminary study of early postoperative rising and walking is made on patients having major intra abdominal surgery. A total of 681 cases were analyzed for postoperative complications and their causative factors. Early rising is defined as rising and walking on the first or second postoperative day.

The patients who rose early were considerably stronger and had less pain in their wounds. They were able to care for themselves on about the fourth postoperative day and were ready for discharge considerably earlier than the control group.

The incidence of wound disruption and wound infection was reduced in the early rising group.

The incidence of pulmonary complications was somewhat lower in the early rising group.

The incidence of deep leg vein thrombophlebitis was observed to be somewhat greater in the early rising group.

It might be postulated that some of the late rising group developed signs of phlebitis of the leg veins at home several days after discharge. If so, it has not been apparent in the follow-up visits which are made days to weeks after discharge.

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APRIL, 1946

RESTORATION OF CONTINUITY VERSUS CURE IN CARCINOMA OF THE RECTUM

THERE is a widespread revival of operations designed to preserve the rectal sphincter in patients with carcinoma of the rectum and rectosigmoid. This aim to preserve the sphincter is a natural outcome of advanced surgical skill and technique on the one hand, and on the other of evidence that primary spread of disease from this region is cephalward. At this time we must carefully weigh the evidence of experience and adopt a rational attitude regarding the problem.

Given a patient with carcinoma of the rectum we must take into consideration the single fact that cure if possible is our obligation. Unfortunately many of these victims arrive in an incurable condition—a fact due mainly to our inadequate educational methods, although at the moment there seems

to be no effective manner in which all cases can be diagnosed in an early state.

In a recent series of 100 consecutive patients with carcinoma of the rectum the average duration of disease before entry into the Massachusetts General Hospital was 18 months. Twenty-eight had such extensive disease that a resection was impossible. Seventy-two had an abdominoperineal resection in one or two stages. There were two deaths in this group—a postoperative mortality of 2.8 per cent. One patient died from hypertensive heart disease, and the other of a pulmonary infarct. About 10 per cent of the resections were done in the presence of hepatic metastases. Including the operative deaths, approximately 45 per cent of the operable cases or 30 per cent of the entire group will live 5 or more years. It appears at this time that only earlier diagnosis will materially improve these results.

The best safest, and most adaptable operation so far devised is the combined abdominoperineal resection of Miles. The Miles technique may be varied in many ways and the operation may be done in one or two stages. This method allows the surgeon to remove the local spread of the disease including the regional lymph nodes and extension to neighboring viscera as well as to perineal muscles. In skilled hands, the mortality rate is low and the morbidity is growing less with better preparation and after-care. This procedure however does leave the patient with a permanent colostomy.

Colostomy is not burdensome to thousands of grateful individuals who have been cured of cancer. With reasonable care they are free to carry on their business, athletic and

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social functions without offense or inconvenience. Sentimental abhorrence of the colostomy by patient and physician has wasted many useful lives. Although none looks forward to a colostomy life with avid joy few will refuse it if the entire situation is explained to them. Taught the simple principles concerning care of the colostomy nearly all of these patients are comfortable and happy.

In performing resections with low anastomosis, one must consider the following rules governing a proper operation for malignant disease. First, have we given the individual patient his greatest chance for cure? Second have we increased his immediate hazard? Third will the morbidity from poor sphincter control or fistula formation justify the procedure? The second and third of these have

been pretty adequately answered in a satisfactory manner. The first concept is not yet determined and it will take considerable time to do so. In reporting results on these procedures surgeons must make it clear that local recurrences have not taken place in those patients whom they would have expected to cure by performing a complete extirpation of the rectum and the muscles of the perineal floor.

The issue is confused by the fact that all of us agree that restoration of continuity is justifiable if the patient has metastatic disease in the liver at the time of operation. These cases should not be considered in the same light as those whose spread of disease was limited to the resectable area at the time surgery was undertaken.

ARTHUR W. ALLEN

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

THE book entitled *Penicillin in the Treatment of Infections*¹ by Keefer and Anderson presents in its 48 pages a clear summary of what is known of penicillin and its effect, but it does not disclose any new facts about its action or administration.

Penicillin seems to act like the sulfonamides by interfering with some metabolic processes of susceptible bacteria and therefore is active only when the bacteria are in a phase of growth and multiplication. In the concentrations that are achieved in living beings its effect is chiefly bacteriostatic and not bacteriocidal. Thus it does not actually eliminate the infecting organisms but inhibits their growth and multiplication. But unlike the sulfonamides, penicillin is not inhibited by pus, peptones, or the breakdown products of tissue autolysis. The sensitivity to penicillin varies with the various species of organisms. It is not understood yet why gram negative bacilli and virus infections are not susceptible to the action of the drug nor why susceptible bacteria may become resistant when exposed to the drug for longer periods. However it has been shown that certain bacteria of the coli group produce a substance penicillinase, which inactivates penicillin. The sensitivity of any bacterial strain to penicillin can be determined and may be very useful in the treatments of certain infections. Of considerable importance is the fact that there is no correlation between resistance to penicillin and resistance to the sulfonamides.

Several biological assay methods for determining the concentration of penicillin in the blood and the body fluids are available. It has been found that 60 per cent of the amount of penicillin injected in the blood stream or the muscles were excreted in the urine within 1 hour and that little or no drug remained in the blood after 3 hours. For this reason, it became evident that the use of large doses of the drug was wasteful since a better bacteriostatic level could be maintained in the blood by the administration of small doses given every 2 to 3 hours. It has also been shown that when mixtures of penicillin in beeswax and peanut oil were injected intramuscularly, the drug was absorbed slowly and the therapeutic effect could thus be prolonged to 6 or 7 hours. The authors recommend for the treatment of systemic infections the intermittent intramuscular administration of penicillin. Intermittent intravenous

infections or continuous intravenous or intracerebral infusions offer no advantages and are considerably less convenient.

The passage of penicillin from the blood into the cerebrospinal fluid or the various parts of the eye is minimal and noneffective. Its passage into the pleural, abdominal and synovial cavities is somewhat more satisfactory. It is therefore recommended to inject penicillin directly into the subarachnoid space, the cerebral ventricles, the articulations, the pleural cavity, the cranial sinuses, the chambers of the eye, etc. Topical application of penicillin to superficial burns skin infections, and infected wounds by means of wet dressings or rubber catheter has given excellent results. The dosage and the most adequate way of administration are discussed for the various methods of administration of penicillin, and the clinical aspect of penicillin therapy is presented with more details in cases of staphylococcal bacteremia of the face, acute hematogenous osteomyelitis, chronic osteomyelitis, staphylococcal pneumonia, multiple subcutaneous abscesses, hemolytic streptococcal pneumonia and empyema, gonorrhea, meningococemia, pneumococcal pneumonia, pneumococcal meningitis, subacute bacterial endocarditis, gas gangrene and syphilis. The toxic reactions are rare, the more common being urticaria and fever.

Penicillin is without doubt the most effective agent for the treatment of infectious diseases. However it should not replace or diminish strict surgical asepsis, the early surgical treatment of wounds, and general medical prophylaxis against infectious diseases.

GEORGE PRINCE

AMONG the noteworthy publications of the Medical Department of the United States Army *Pathology of Tropical Diseases*² by Ash and Spitz will find a place in the first rank. It fills a need met by textbooks on tropical medicine, which rightfully place emphasis on etiology, clinical features, epidemiology, diagnosis, and treatment. This atlas, which is a collection of 641 photographs, photomicrographs, roentgenograms, and drawings, offers visual material in highly acceptable form. It is obvious that the authors had a wealth of material at hand, because nearly every illustration is one of the best possible. The technical quality of the reproductions is uniformly good. There is no doubt but that the publisher took the greatest pains to make this book as nearly perfect as he could.

¹ *PENICILLIN IN THE TREATMENT OF INFECTIONS*. By Chester S. Keefer, B.S., M.S., M.D., Sc.D. (Bos.), and Donald G. Anderson, A.B., M.D. New York, London, Toronto. Edited by Henry A. Charles, A.M., M.D., LL.D., Sc.D. (Hon.). P.A.C.F. Hon. F.R.C.P. (Can.) Oxford University Press, 1943.

² *PATHOLOGY OF TROPICAL DISEASES: A TLAS*. By J. E. Ash, Colonel, M.C. U.S.A., and Stephen Spitz, M.D. C.S. A.U. Philadelphia and London: W. B. Saunders Co. 1943.

REVIEWS OF NEW BOOKS

Nearly every disease to be found in the tropics, from alinlum to yellow fever is dealt with. Brief explanatory notes which include enough information to orient the reader and sketches of the epidemiological facts are provided. The salient features of each disease are presented in excellent photographs or x-ray pictures.

This is an authoritative book. Although atlases are often thought of as supplementary works this particular one is outstanding because it is a highly intelligent contribution designed specifically to illuminate where illumination is most needed. It is recommended to students of tropical medicine and to pathologists who will be confronted with the sequelae of tropical diseases.

HENRY R. JACOBS

A LONG standing gap has been filled by Thomas and Hadden's *Amputation Prostheses* by bringing together two authorities who have combined their knowledge to present a practical guide for surgeons and practitioners on the proper use of prosthetic appliances. This dual authorship—a surgeon and a manufacturer of artificial limbs—provides a common ground for discussion of the problems of the amputee.

The mutilating injuries of war have awakened an increased interest in amputations surgical technique and prosthetic appliances. It has been estimated that the number of amputations resulting from the First World War totaled 500,000 for all nations engaged. Amputations among the armed forces of the United States were relatively small, however numbering only about 4,000. During the Civil War there were well in excess of 30,000 amputations in the Union Army alone. Figures for the Second World War released as of July 1, 1945 reveal that over 15,000 amputation cases have been treated in the various amputation centers established by the Army and Navy of the United States and no doubt there will be many more before the toll of the war is ended. The total number of amputations resulting from World War II will probably exceed a million.

The number of amputations performed each year among the civilian population of this country far exceeds amputations performed in the armed forces even in wartime. The American Federation of the Physically Handicapped has estimated that there are approximately 75,000 new amputation cases in this country every year and that of this number 40,000 are major amputations requiring prostheses. The National Safety Council has reported that, prior to World War II 32,500 amputations resulted annually from accidental causes alone. Reliable estimates reveal that there are now approximately 925,000 amputees living in the United States. The artificial limb manufacturers of this country report that prior to the present war they were supplying prostheses to more than 70,000 persons annually.

In the past, too little attention has been paid by surgeons to the problem of the artificial limb which the amputee must wear throughout life. As a result, amputations rarely have been considered from the prosthetic point of view.

There is a great need for closer co-operation between the surgeon and the limbmaker. Occasionally and unfortunately surgeons, through lack of information fail in advising the patient as to his permanent prosthesis or in supervising its fitting. Few surgeons are familiar enough with prosthetic appliances or limb fitting to give such advice.

There is a definite need for a practical text devoted to the amputation prosthesis. Such a text to be of value, should be concerned primarily with principles of fitting and aligning the prosthesis and with instructions as to its use. In this book, the surgeon and limbmaker have collaborated combining the scientific knowledge and training of the surgeon with the mechanical skill and practical experience of the limbmaker in order to give to the physician and the limbmaker alike a practical manual on the selection fitting, and use of artificial limbs.

In the construction of the amputation prosthesis, emphasis is placed on simplicity of design and lightness of weight with durability. Materials used are important only insofar as they are light and durable and lend themselves readily to the necessary adjustment of alignment and fitting. The choice of materials often will vary according to the individual needs of the amputee depending upon such factors as the site of amputation and the age, sex, occupation, and physical condition of the amputee.

Elaborate and complex joint mechanisms and control, despite extravagant claims of manufacturers and salesmen, are not essential in the average prosthesis. They add considerably to the original cost, are more difficult to adjust and repair and offer few, if any advantages over the more simple standard types. The ordinary amputation prosthesis is really a very simple apparatus mechanically, and if it is properly aligned and fitted it fulfills its functions most satisfactorily without complicated mechanisms.

Of far greater importance than materials and types of joint mechanisms in the successful use of the prosthesis are the proper alignment and fitting of the limb. This requires considerable skill based on experience and judgment, and a thorough understanding of certain fundamental anatomic and physiologic principles. Surgeons and limbmakers alike have been too prone to place undue emphasis on the importance of materials and complex mechanical devices, neglecting the all important principles of alignment and fitting. In this text considerable attention is given to these fundamental principles.

Both the surgeon and limbmaker should guard against unwarranted claims and against encouraging ill founded hopes on the part of the amputee.

One chapter of the text pertains to prostheses for children—a subject which presents certain special problems and which heretofore has been given little or no attention in surgical texts.

A chapter is also devoted to the subject of the rehabilitation of the amputee. Particular emphasis is placed on the importance of the emotional readjustment of the amputee to his handicap. Attention is directed also to the necessity for instruction and training in the proper use of the prosthesis. Vocational guidance and selective placement in employment are also emphasized. Consideration of these problems, so often neglected, are of the greatest importance in the successful rehabilitation of a person handicapped by the loss of an extremity.

Special acknowledgment is given to Captain Henry Kewler MC USNR, for use of photographs and diagrams demonstrating his cineplastic amputations and illustrating postoperative care of the stump preparatory to fitting the prosthesis, as well as for his valuable contribution on the subject of rehabilitation of the amputee.

The text covers the following subjects: development of modern amputation prostheses; the amputation stump; prostheses for amputations of lower extremity; alignment and fitting of lower extremity prostheses; upper extremity prostheses; prostheses for children; and rehabilitation of the amputee.

In comparison with some widely publicized contributions on the same subject, the reader will find the present volume a pleasant relief. The book is remarkably practical throughout. The illustrations are unusually instructive.

PHILIP LUTWY

Movements of the Stomach and Duodenal Bulb indicates that the human stomach consists of four parts. Each part is homologous with each of the four stomachs of ruminants. He suggests that the fourth of the human stomach is homologous with the rumen and the corpus with the reticulum (second stomach). These constitute the longitudinal stomach. The transverse stomach which is usually referred to as the pars pylori, beginning at the incisura, he divides into three parts. The "sinus" fans out downward from the incisura forming the "knee" or "elbow" at the greater curvature. The "membrana angularis" fans out upward from the junction of the sinus with the pyloric canal, to form a bulge on the lesser curvature between the incisura and the pyloric canal. Thus, the sinus and membrana angularis form what is frequently referred to as the pyloric vestibule and the pyloric canal, called the pyloric antrum or "prepyloric region." The duodenal bulb appears to be correlated with the pyloric sphincter, which structure contains a duodenal as well as a gastric component.

His anatomical description of the arrangement of the muscular fibers in the stomach in relation to the pyloric portion of the stomach and sphincter is enlightening.

The book is recommended to all students of the anatomy and physiology of the stomach.

ARTHUR J. ARTHUR

THE MUSCULAR BUILD AND MOVEMENTS OF THE STOMACH AND DUODENAL BULB, ESPECIALLY ITS RELATION TO THE FUNCTION OF THE SEVERAL DIVISIONS OF THE STOMACH IN THE LIGHT OF COMPARISON A STUDY IN ENATOMY. By John Thompson, ChM, FRCGS, F.R.C.S. (Edinburgh) and Frederick Baskerville, 1942.

AS a result of his deductions from a study of the embryology and comparative anatomy of the stomach the author of *The Muscular Build and*

CORRESPONDENCE

BLOOD AMYLASE ACTIVITY IN PANCREATITIS AND OTHER DISEASES, A SIMPLE DIAGNOSTIC AID—A Correction

IN the February 1946 issue of SURGERY GYNECOLOGY AND OBSTETRICS a correction should be made in the captions for the color insert which appears opposite page 115 in the article entitled

"Blood Amylase Activity in Pancreatitis and Other Diseases—A Simple Diagnostic Aid" by David Polowe. In row C the third figure should be labeled $++\pm$ ($\pm 25+$)

April, 1946

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INTERNATIONAL ABSTRACT OF SURGERY

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ABSTRACTS OF CURRENT LITERATURE SURGERY OF THE HEAD AND NECK

EYE

Ridley H.: Ocular Manifestations of Malnutrition in Released Prisoners of War from Thailand. *Brit. J. Ophth.*, 1945 29 613.

The author reports on the unique opportunity offered by the examination of 500 released allied prisoners of war and internees from Thailand who believed that their vision had deteriorated during their captivity. Food had been deficient in quantity and especially lacking in proteins, fats, and vitamins. Meals had consisted mostly of polished rice vegetable stew, a small quantity of meat and tea. For a period of 6 months the food had been reduced nearly to the starvation level, with only rice and salt for one period, and it was during this time that most of the visual symptoms occurred. Ninety of 100 patients were amblyopic.

In many cases the amblyopia had occurred during a single day; in others the onset was more gradual. Night blindness was uncommon. Campimetry revealed in 90 cases a small central scotoma not usually extending over 3 degrees from the fixation point, although in the severe cases it was much larger. Many patients showed normal fundi, but in others a temporal pallor of the disc was noted. Altogether there were 48 definite and 50 doubtful cases of optic atrophy.

Practically all of the released prisoners showed some degree of keratoconjunctival abnormality usually an increased vascularity at the limbus with the formation of aneurysms, and vessels and opacity extending into the cornea for about 2 mm. There were 3 cases of interstitial keratitis with negative Kahn tests.

While there seems no doubt of the relationship of the visual disorders described to the nutritional deficiency the author is inclined not to place the entire blame on a single vitamin deficiency but rather on the general malnutrition of the prisoners. However some of the changes described might well be secondary to deficiency in vitamins of the B group. There was noted a high incidence of arcus senilis in this relatively young age group and this also suggests a derangement in fat metabolism.

Treatment in these cases included a full diet and supplemental vitamin therapy. The author plans to offer a later report showing the results which have been achieved. In the severe cases with marked optic atrophy too much improvement is not to be expected. Visual acuity at the time of the original examination varied from 1/60 to a partial 6/6.

WILLIAM A. MANN M.D.

Sen K., and Ghose, N.: Ocular Gnathostomiasis. *Brit. J. Ophth.*, 1945 29 618.

Few cases of parasites recovered from the eye have been reported. The author reports the first case of gnathostomiasis in the human eye. In fact, this infection is quite rare in the human being and up to 1937 only 24 definite and 60 clinical cases had been reported and these involved the stomach, lungs, kidneys, mastoid and subcutaneous tissues.

The present instance occurred in a 26 year old Hindu who was admitted to the hospital for investigation of an orbital cellulitis with hemorrhages in the retina and vitreous of the left eye. He developed an iritis and after a considerable period of treatment a moving pigmented nodule was noted in the anterior chamber imbedded in the iris. Slit lamp examination revealed it to be a worm.

The parasite was removed after a retrolbulbar injection to reduce the intraocular tension (which had been elevated). After a suitable incision with a thin Grace knife the worm was removed *in toto* with a curette. Recovery was uneventful. Later examination showed the disc to be atrophic and the arteries thin and sheathed, and there was a pigmented scar below the macula. As this was not present on the first examination it was believed to be the point of entrance for the parasite. WILLIAM A. MANN M.D.

Rosen E.: Diabetic Needles. *Brit. J. Ophth.* 1945 29 645.

The author points out that in diabetes characteristic changes can be found in the lens in addition to the accepted ocular signs of diabetes such as rubeosis iridis, small globular hemorrhages at the macula, retinitis proliferans, retinitis circinata, and den onset of hyperopia, and lipemia retinalis.

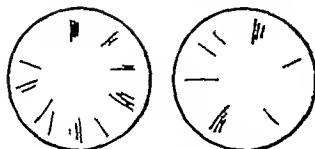


Fig. 1. In this case the patient had no knowledge of having diabetes. The vision was 20/200 in each eye, and was correctible to 20/30 in each eye. Examination of the lens revealed the presence of diabetic needles. The fundus showed no evidence of diabetes. Urine examination disclosed the presence of sugar.



Fig. 2. In this case the patient was 60 years of age. She had had diabetes for 5 years. Diabetic retinitis was present especially at the macula. In the periphery of each lens there were several diabetic needles superimposed upon the incident cortical opacities.

He describes a lenticular sign in diabetics which when present is considered specific for diabetes. It is known as the diabetic needle or "roman numeral" sign—a linear black spoke in the periphery of the lens which is no thicker centrally than it is peripherally. In all cases the spokes were never thicker at the periphery of the lens than at its center and they were seen best with the indirect ophthalmoscope or the retinoscope.

A series of 10 cases which presented these so-called "diabetic needles" is reported. Many of the cases also presented nuclear and cortical lenticular opacities.

JOSUUA ZUCKERMAN, M.D.

Smelser, G. K., and Ozanian, V.: The Effect of Local Anesthetics on Cell Division and Migration following Thermal Burns of the Cornea. *Arch. Ophthalmol.*, Chic., 1945 34: 271.

Smelser and Ozanian discuss the effect of local anesthetics on cell division and migration following thermal burns of the cornea.

They conclude

1. Topical application of most anesthetics inhibits mitosis in the intact corneal epithelium if they are of a sufficient concentration to produce anesthesia.

2. The inhibition of cell division varies with the drug, the method of administration and the frequency of application.

3. If anesthetics are applied locally to closed burns the migration of epithelial cells over the injured area is markedly inhibited.

4. Most anesthetics also inhibit cell division in the regenerating epithelium.

5. Some drugs inhibit mitosis but do not retard cell migration.

6. Nupercaine and phenacaine ointments produce prolonged surface anesthesia, but do not impair mitosis in normal epithelium nor retard cell division or migration in regenerating epithelium.

7. Unbuffered aqueous solutions inhibit healing more than ointments of the same or of greater strength.

JOSUUA ZUCKERMAN, M.D.

Roper, K. L.: Senile Hyaline Scleral Plaques. *Arch. Ophthalmol.*, Chic., 1945, 34: 253.

The author reviews the literature on a dual asymptomatic entity he calls "senile hyaline scleral plaques" and reports 5 cases of his own. These plaques, which are rectangular, round, or oval and of a slate gray color, are symmetrically situated about 3 mm. from the limbus and about 5 mm. anterior to the insertions of the lateral or more frequently of the medial rectus muscles. The plaques are slightly depressed and translucent. Clearly. Patients are generally unaware of the presence of the condition.

Advanced age associated with dehydration and progressive sclerosis is considered the most predisposing factor in the disease. It probably is due to a local nutritional disturbance resulting from arteriosclerosis and the stress and strain on the sclera. For this reason the term "senile hyaline scleral plaques" is preferred to more colorful names.

As far as a differential diagnosis is concerned, the author points out that scleromalacia perforans is primarily necrotic in origin, whereas scleral plaques are degenerative. Brawny scleritis is an invasion by granulation tissue and plasma cells and scar tissue is deeply pigmented, whereas scleral plaques are pale and nonpigmented.

JOSUUA ZUCKERMAN, M.D.

EAR

Hall, I. S.: Fenestration of the Labyrinth. *J. L. Otol.* Lond., 1945 60: 200.

The author reports his experiences with the fenestration operation for deafness due to otosclerosis in 71 cases during the past 6 years. The method of operation is essentially the one stage procedure developed by Lempert from the multiple stage procedure of Sourcil. A pedicle flap consisting of the thin skin of the bony posterior and superior walls of the external canal attached to the drum membrane is preserved to cover the fenestrum. The author prefers the postauricular mastoid incision to the endaural approach. The annulus tympanicus is re-

moved in the upper portion and the incus and head of the malleus is resected using care to preserve the skin flap attached to the drum in an undamaged state. A dissecting microscope is used while working on the labyrinth capsule. General anesthesia, consisting of heavy premedication and light ether is favored since immobility of the patient is desirable when using the microscope. The fenestrum is made over what is considered to be the ampulla of the horizontal canal. Electrically driven burrs of various types are used. Important points in the making of the fenestrum are considered to be the use of irrigation to remove bone dust and the care with which the endosteum and small bone chips are removed by means of small scrapers and needles. Paraffin gauze is used to hold the skin flap in position and is removed after from 5 to 7 days. Skin grafting of the cavity is sometimes carried out at the time of the first dressing by either the Thiersch or pinch method.

The results have shown a steady improvement over the 6 year period and approximately 55 per cent of operations during the past year are considered to be successful. Revision of a fenestrum which has closed is a more delicate procedure than the primary operation and entails greater risk to the membranous labyrinth. The opinion is advanced that even in cases in which the fenestrum has closed subsequent deterioration of hearing appears to be arrested as has been shown by comparison with the opposite ear. Failure to orient sounds has been noted on several occasions following the fenestration operation but vertigo has not been troublesome after the first weeks. The causes of failure which are commonly met are closure of the fenestra, advancing age and the presence of nerve deafness, infection, and technical failure.

NOSE AND SINUSES

Bernfeld, K. The Genesis of Typical and Atypical Cysts of the Nasal Floor. *J. Lar. Otol. Linc.* 1945 60 145

The term 'cyst of the nasal floor' is applied by the author to prominences of the vestibulum of the nose, situated either just in front of or behind the apertures pyriformis, extending to the lateral corner of the nasal floor and containing a liquid matter. They are rather rarely encountered. As a result of the author's experience it appears that small soft cushions of the mucous membrane with very little or no contents, are considerably more common. If, in the routine examination rhinologists did not omit the lowest, most laterally situated corner of the nasal cavity formations of this type would not be compressed nor escape attention. The author believes it may be helpful to clarify the genesis of these peculiar cystic formations.

The distinction between typical and atypical cysts has been made from a clinical and not from a genetical viewpoint. The diagnosis offers no special difficulty if the cyst is found at its typical site within the soft parts.

Palpation from underneath the upper lip with simultaneous probing will at once clarify the nature of the tumor found there. Aspiration yields a translucent yellowish fluid in which usually no cholesterol is contained.

The most important cyst in differential diagnosis is the radicular dental cyst excluded by radiography. As long as the typical or atypical cysts are small and cause no symptoms, any kind of treatment is superfluous. If however the growth of the cyst suppurates, or some other condition makes its removal imperative the procedure should be a radical one by peroral approach underneath the upper lip. The operation should be followed by cauterization which ensures a firm scar.

The total number of cases presenting typical nasal floor cysts was 3, that of atypical ones 21. 4 of the patients were children (3 girls of 8, 11 and 12 years, respectively and 1 boy of 7) 17 were adults between the ages of 18 and 38 years. The cysts occurred unilaterally in 13 cases (in 8 cases on the right) and bilaterally in 8.

JOHN F. DELANEY, M.D.

Beck, A. L. Abscess of the Nasal Septum Complicating Acute Ethmoiditis. *Arch. Otolaryng. Chic.* 1945 43 275

Abscess of the nasal septum may result from infection anywhere in the neighboring tissues, but such abscesses occur most frequently after accidental or surgical trauma. The pus may be found on one side or on both sides of the cartilaginous and bony framework. The author reports 2 cases in both of which incision on one side only was adequate.

The cartilage apparently disintegrates for fragmentation or sequestration of cartilage or bone is not always recognized at the time of and following surgical drainage. Abscess of the septum following trauma is preceded by the formation of a hematoma between the mucoperichondrium and the cartilage. Abscess following sinusitis probably is not preceded by the formation of a hematoma. There was no hematoma in either of the cases reported.

Abscess resulting from injuries accompanied by simple and compound fractures of the nasal bones must be a rare occurrence since the author has not observed it over a period of many years. Observations of persons injured in automobile accidents as they appear in the accident room of the hospital serve as the basis for this statement.

Abscess of the septum has been reported following endonasal anastomy performed through the inferior meatus. This may possibly result from instrumental trauma to the lower part of the septum in the performance of the operation.

The one infallible symptom of septal abscess is complete usually bilateral, obstruction of nasal breathing. Tenderness, pain in the nasal and orbital regions and swelling of the nose are also present. The mucosa covering the septum does not shrink when epinephrine hydrochloride and other vasoconstrictors are applied.

JOHN F. DELANEY, M.D.

MOUTH

Pignatelli, G: Solitary Neurinoma of the Tongue
(Neurinoma solitario della lingua) *Glor ital chir*
945 24

The author describes a solitary neurinoma of the tongue in a patient aged 36. The condition had been in existence for 8 months. The tongue had a normal color was moist and showed no impairment of its movements. A tumefaction was palpable at the tip of the tongue this was elastic, of rather hard consistency and was not sharply circumscribed. Pain could be provoked only by strong pressure. The lymph glands were not involved and the Wassermann, Sachs, and Meinicke reactions were negative.

Various conditions had to be considered in the differential diagnosis. Cavernous angioma is easily recognizable by its color and compressibility. A circumscribed lymphangioma is relatively hard and is usually found on the lower surface of the tongue. Ungual papillae are usually enlarged. Carcinoma or sarcoma of the tongue has a rapid evolution. Fibroma usually has a submucous location but it may be pedunculated. Lipoma, as a rule resembles a fibroma clinically but its consistency is softer. Syphilis of the tongue in the form of a gumma involves the surface of the tongue and shows a tendency toward ulceration. The blood examination confirms the diagnosis. A tuberculous granuloma as a primary manifestation of tuberculosis is very rare as a rule signs of pulmonary or intestinal tuberculosis are present. Actinomyces of the tongue shows a rapid evolution and the hard nodules gradually become soft and lead to the formation of fistulas. Hydatid cysts of the tongue are extremely rare and reach a considerable size. Glandular cysts usually have a marginal location. Congenital cysts are found at the base of the tongue and in the region of the lingual V.

The author removed the tumor under local anesthesia. Its weight was 30 gm. The histological diagnosis was neurinoma. Such tumors originate from Schwann's sheath. Several varieties of the tumor such as neurofibroma or neurinoma sarcomatodes, and neurocytoma, have been described. Parallel fibrillae cemented together with a protoplasmatic substance and nuclei located at various heights are characteristic for neurinoma. The location of the neurinoma at the tip of the tongue is very rare. No anatomic connection between the tumor and a nerve trunk could be established. Many workers consider the tumors to be hamartomas or aberrant formations of neuroblastic origin.

JOSEPH K. NARAY, M.D.

NECK

Shriver, J. W., and Cohen, M.: The Effects of Thioarsacil on the Thyroid Gland. *Ann. Int. M.*, 1945, 23 790.

Six hyperthyroid patients were treated with thioarsacil for varying periods to prepare them for

thyroidectomy. These periods were relatively short, from 9 days to a month, except in 1 instance in which the thioarsacil medication was continued for 7 months. Two of these patients had previously been prepared with iodine and subjected to a lobectomy and the histological picture at the first operation had shown the more or less typical iodine involutions effects.

At the second operation the remaining lobe in 1 of these patients exhibited the typical hyperplastic thioarsacil picture, i.e., small empty acini and pale granular cells with large pale central nuclei, while in the other case the histological picture resembled a simple colloid goiter, unaffected by the thioarsacil except in isolated hyperplastic patches where the typical thioarsacil effect was evident. In nearly every instance the gland or lobe appeared friable and vascular upon removal, no matter what the amount or character of the preparation, and the postoperative reaction was rather severe, even approaching that of the thyroid crisis. Nevertheless, in 1 patient, to whom no iodine had been administered and to whom thioarsacil had been given for only 5 days preoperatively the gland did not appear vascular or friable and the postoperative reaction was mild, and yet the microscopic picture revealed a typical thioarsacil effect. In other words, it was not always possible to correlate the clinical and the pathological pictures in this series.

In the case of the patient who had taken thioarsacil for 7 months preoperatively no mention is made of gland friability and there was no postoperative reaction, the microscopic picture showing a patchy architecture with hyperplastic areas, which was more like an untreated Graves disease than a typical thioarsacil effect. This was interwoven with lower darker celled acini and large masses of colloid, which gave the appearance that the gland was undergoing a colloid involutary process.

Although it is admitted that thioarsacil will control clinical hyperthyroidism in the patient who has undergone operation as well as in the patient who has not been subjected to it, the authors are of the opinion that iodine is still the drug of choice for preparing the thyrotoxic patient for operation. Their opinion is based upon the technical difficulties experienced by the surgeon because of the increased vascularity and friability of the gland which has been prepared with thioarsacil, the frequent stormy postoperative course, and the fact that standards have not as yet been set up to determine when the patient under thioarsacil medication is ready for operation.

Many excellent photomicrographic reproductions accompany the original article.

JOSEPH W. BRIDGES, M.D.

Bartals, E. C.: Thiobarbital in the Treatment of Hyperthyroidism. *J. Am. M. Ass.* 1945, 137 932.

Astwood has reported that diethyl thiobarbitone acid (thiobarbital) has antithyroid activity similar

to that of thiouracil. Experiments on rats showed that thiobarbital in small doses was somewhat more effective in inhibiting thyroid function and perhaps less toxic than thiouracil. However animals which received thiobarbital in larger doses were found to have fatty infiltration of the liver.

The opportune moment for the author's initial trial of thiobarbital came in October 1944, when a patient receiving thiouracil developed a fever reaction which necessitated discontinuance of treatment but further antithyroid therapy was essential before thyroidectomy. This first experience with thiobarbital revealed that this drug has unquestionable antithyroid action in human beings and that sensitivity to thiouracil does not preclude its use.

Thiobarbital has now been used at the Lahry Clinic in the treatment of 28 patients with hyperthyroidism and definite and satisfactory antithyroid response was obtained in all.

Of 9 patients in whom toxic reactions to thiouracil developed 7 tolerated thiobarbital which produced complete relief of the hyperthyroidism.

Eight of the 28 patients receiving thiobarbital, or 28 per cent, developed toxic reactions to the drug. The depressive change in the white blood cells was the only serious reaction. Two patients developed agranulocytosis. There was no death due to the drug.

The time required to control hyperthyroidism with thiobarbital was found to be the same as that with thiouracil. The antithyroid effect of thiobarbital is apparently twelve times that of thiouracil, since 0.05 gm. of thiobarbital accomplished the same result that 0.6 gm. of thiouracil accomplished. Since no side effects were observed with the smaller dose (0.05 gm.) further studies with this dose seem justified to determine its clinical effectiveness.

The anesthesia and postoperative course of patients treated with thiobarbital is similar to that of the thiouracil treated patient. The combined use of thiobarbital and iodine produced satisfactory involution of the thyroid gland.

The high percentage of reactions to thiobarbital has led to the use of thiobarbital for only those patients unable to tolerate thiouracil.

JOHN E. KIRKPATRICK, M.D.

Barr D. P., and Shorr E.: Observations on the Treatment of Graves Disease with Thiouracil. *Ann Int M.*, 1945 23 754.

Among 100 cases of thyrotoxicosis treated with thiouracil, remission was induced in 87. The drug exerted a beneficial effect on emaciation tremor hyperkinesia, and the circulatory symptoms also on the basal metabolic rate cholesterol levels the creatine defect and on the tendency of thyrotoxic patients to lose nitrogen calcium and phosphorus. Protrusion of the eyeballs was not decreased but lid spasm and lid lag were decreased or controlled.

Benefit from thiouracil was often apparent in less than 10 days, and normal conditions were usually attained within 40 days. Factors tending to retard

the rate of response were the previous use of iodine and large nodular goiters.

Of the 100 cases, 73 presented successful results in the sense that the thyrotoxicosis was maintained in remission. In 37 of the 73 cases, the drug was withdrawn for from 2 to 16½ months without relapse.

There were 3 deaths from circulatory complications, but none could be justly ascribed to the action of the drug. In 12 cases unfavorable symptoms resulted in withdrawal of the drug. Two cases of agranulocytosis were encountered.

SAMUEL KAHN, M.D.

Saltman M. F.: Carcinoma of the Larynx. Significance of the Histopathological Study of Serial Sections; Preliminary Report. *Arch Otolaryng.*, 1945 42 178.

This report concerns itself with the histological study of a block of laryngeal tissue removed by thyrotomy. The block of tissue included about 0.5 cm. of the anterior end of the right true and false cords.

Microscopic study revealed incomplete removal of the cancer *in situ* of the right true cord. Although the lesion involved almost exclusively the region of the glottic lip of the entire length of the true cord tissue there was no subglottic or ventricular extension. The presence of a greater length of cancer *in situ* anterior to the horisifying carcinoma, and of only a small amount posteriorly caused the author to conclude that the lesion grew to the anterior commissure and extended to the opposite cord.

A true picture of the laryngeal pathological changes could not be determined from the original specimen. It is believed that serial histological studies of laryngofissure specimens would prevent delay in the management of residual malignant neoplastic tissue.

NOAH D. FABRICANT, M.D.

Ivanovitch O. and Ferrari R. C.: The Treatment of Extensive Pharyngostomies following Laryngectomy (El tratamiento de los grandes faringostomas consecutivos a la laringectomia). *Boletín del Club B. Air.*, 1945 21 266.

Before the development of the modern technique extensive pharyngectomy following laryngectomy was frequently necessary because of necrosis and infections of the operative field. As a rule such infectious processes heal spontaneously or the remaining small fistulas close following minor surgical procedures. However in a certain number of cases infections or necrotic processes produce an extensive pharyngostomy especially if a large portion of the anterior aspect of the pharynx perishes. Fortunately such cases are rare.

As a rule pharyngostomies develop in patients irradiated prior to the operation because the connective tissue undergoes certain changes. Because of such changes in the surrounding tissues a repair of pharyngostomy is very difficult and disruption of the wound is the rule rather than the exception.

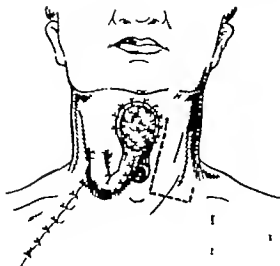


Fig. Second stage of the operation.

In 4 cases the authors succeeded in reconstructing the pharynx by using a tubular cervicothoracic flap. When the suture line of the tube formed a scar the circulation at the distal end of the tube was inter-

rupted by the application of an elastic forceps for gradually increasing periods of time. When in the surgeon's opinion the blood supply to the tube from the proximal end was sufficient, the lower end was severed and the so-called delayed flap was placed in proper position to cover the defect in the pharynx. The proximal end of the tubular flap was placed in the vicinity of the pharyngostomy while the lower end of the tube was placed below the clavicle and more to the side than the proximal end. To cover the defect, the distal end of the tube was turned upward and the upper portion of the tube was sectioned. The defect which was produced by formation of the tubular flap was closed with interrupted sutures.

Another rectangular flap was prepared from the opposite side of the anterior aspect of the neck, with the base at the level of the defect in the pharynx. The flap was rotated 90 degrees so that instead of pointing downward, it lay in a horizontal direction. The defect created by the change of the position of the rectangular flap was covered by a transplantation of a free flap from the subclavicular region.

Chromic catgut was used for suturing the tubular flap to the pharyngeal wall.

JOSEPH K. NABAT, M.D.

SURGERY OF THE NERVOUS SYSTEM

PERIPHERAL NERVES

Sunderland, S.: The Blood Supply of the Peripheral Nerves; Practical Considerations. *Arch. Neur. Psychiat. Chic.*, 1945 54 480.

Free and extensive mobilization of the nerves, often required in peripheral nerve surgery necessitates the division of many articular nervorum which bind the nerve to an accompanying arterial channel. The sacrifice of many nutrient vessels fortunately does not seriously jeopardize the nutrition of the nerve. Nerves are abundantly vascularized the anastomoses are numerous, and there is considerable overlap of supply. Experimental work has shown that the collateral circulation of a nerve is efficient even when the nerve is freed from the surrounding tissues over a considerable distance.

The author suggests the preservation of the superficial longitudinal vessels which lie in the epineurium and anastomose along the course of the nerve and advises ligation and division of the nutrient vessels some distance away from the nerve in order to preserve the vascular anastomoses. Furthermore

should a large nutrient vessel be torn or divided at the surface of the nerve it may retract into the epineurium and cause troublesome hemorrhages which result in damage to superficial nerve fasciculi and the formation of an undesirable scar

GEORGE PERREY M.D

BRAIN AND ITS COVERINGS; CRANIAL NERVES

Eaglesham D C.: Radiological Aspects of Intracranial Pneumocephalus *Brit J Radiol.*, 1945 18 335

The author states that head injuries may lead to the introduction of air into the cranial cavity and he discusses its occurrence in 23 cases observed at the Basingstoke Neurological and Plastic Surgery Hospital R.C.A.M.C from July 1942 to April, 1945

The great majority of cases occur in conjunction with fractures through the accessory air sinuses. Nontraumatic pneumocephalus may result from erosion through the paranasal sinuses of a tumor or an infective process. Although gas producing organisms may be introduced into the cranial cavity with lumps may be introduced into the cranial cavity with a resultant formation of gases these are considered essential to the discussion especially with regard to the differential diagnosis. Two examples of this condition are given in which the underlying pathological process was cerebral abscess

The radiological points favoring gas producing cerebral abscess as contrasted with other causes of pneumocephalus, are (1) the gas is remote from the usual source of pneumocephalus, i.e. the accessory sinuses (2) multiple gas pockets are close together and (3) a larger space-occupying effect than the amount of gas would suggest with a pineal shift.

Points favoring intracerebral pneumocephalus rather than gas producing abscess are (1) the presence of gas in the subarachnoid or subdural space in addition to that in the cerebrum, and (2) a rapid appearance or a rapid increase in the amount of gas seen. This, for instance may sometimes occur in traumatic pneumocephalus if the patient blows his nose

Porencephaly may also be confused with pneumocephalus after an encephalogram has been made. In porencephaly the ventricular shift, if any is to the affected side more gas is seen than was considered to have been introduced the gas pocket is at a distance from the accessory sinuses and there is persistence of the gas pocket after the air is absorbed from the ventricles and the subarachnoid space. Intracranial lipomas may give a certain radiotranslucence but less than air or gas and in the case of the latter there is not any calcification at the margins. On occasion air introduced accidentally at lumbar puncture may appear in the cranial cavity

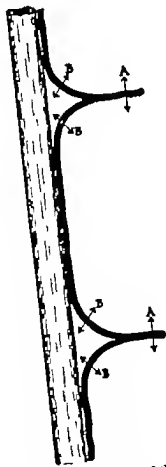


Fig 1 Superficial blood supply of the peripheral nerve.

From the standpoint of radiological technique, stereoscopic views are always necessary to determine the extent of the shadows. An attempt should also be made radiologically to determine the source of the gas. This involves a study of the nasal and mastoid sinuses, with special reference to the cribiform plate.

All of the cases under discussion were of traumatic origin. Only 6 were due to gunshot wounds, the others being so-called closed head injuries which occurred in road accidents. The total number of patients with gunshot wounds, from which the 22 cases were culled, was 824. In some cases the exact origin of the pneumocephalus was not found. Four patients developed meningitis. When the possibility of pneumocephalus exists, radiological re-examination may be necessary from time to time.

ADRIEN VERRODORICH M.D.

Rodríguez, B., Barrios, R. R., and Oreggia, A.: A New Type of Pedunculate Syndrome. Anterior Nuclear Ophthalmoplegia and Bilateral Cerebellar Syndrome Caused by Tegmental Lesion (Un nuevo tipo de síndrome peduncular. Ophthalmoplegia internuclear anterior y síndrome cerebeloso bilateral por lesiones tegmentales) *Arch. neurol. med.*, 1945 7 353

The author reports the clinical history of a 63 year old woman who developed a vascular syndrome of the mesencephalon. The area of softening was located in the peduncular tegmentum. The clinical picture, which had a sudden onset, comprised two groups of disturbances: paralysis of the associated ocular movements of a very peculiar type (anterior internuclear ophthalmoplegia) and a bilateral cerebellar syndrome with dysarthria. In the early stages of the disease there was also a hemiplegia which receded rapidly. Several signs pointed to the involvement of the posterior longitudinal bundle. The motor inco-ordination comprised hypotonus, hypermetria, asynergia, and adiadokochesis.

The authors consider the lesion as belonging to the mesencephalic syndrome and they propose the name of oculocerebellar syndrome caused by a tegmental lesion.

JOSEPH K. NARAY M.D.

Worth, L. H.: Staphylococcal Leptomeningitis Treated with Intracisternal Penicillin. *Lancet*, Lond. 1945 249 634.

The author presents the case of a soldier who was admitted to the hospital with a diagnosis of epilepsy. A lumbar puncture was done. Ten days later the site of the puncture was found to be infected and an interapical abscess was opened. Penicillin was given intramuscularly preceding and following the operation, but no benefit was observed.

Almost a month later the patient was again operated upon. At this time an extradural abscess was found and drained through a small laminectomy opening. After a period of 4 days obvious leptomeningitis was diagnosed. Another laminectomy, with removal of all dead bone, was done. A pocketed

extradural abscess was drained. Cisternal puncture revealed cerebral fluid with 11,000 white cells and a definite staphylococcus aureus on culture. Large doses of penicillin were given by the cisternal route and the patient recovered.

The author reviews the experiences of other individuals who have used penicillin either intracisternally or cisternally. He believes that the cisternal route of administration offers advantages over the lumbar route in pyogenic meningitis, and discusses the reasons for this.

PAUL MERRITT, M.D.

Blumenfeld, C. M. and Gardner W. J.: Disseminated Oligodendroglioma. *Arch. for Psychiat.* Chic., 1945, 54: 274.

The authors present a case of oligodendroglioma which was disseminated throughout the ventricles and in the leptomeninges. The patient was examined over a period of 14 years during which he underwent a craniotomy twice. At the age of 17 he developed headaches and petit mal-like attacks and showed signs of dyspraxia with roentgenological evidence of a pituitary gland tumor. Encephalography revealed a dilatation of both lateral and the third ventricles, and at operation a thickened arachnoid was found in the region of the optic chiasm. The patient continued to have headaches and attacks, but lost many of his hypokinetic characteristics. Skull films made at the age of 24 showed calcifications in the tips of both inferior horns and in the left posterior horn of the lateral ventricles. At the age of 31 he developed convulsive seizures, ataxia, hypotonia, and had a bilateral optic nerve atrophy. He was then reoperated upon, and a cystic tumor was found posterior and superior to the optic chiasm. The patient died, and at autopsy a tumorous growth was found plastered on the walls of all the ventricles, the aqueduct of Sylvius, and the leptomeninges in various areas. The main portion of the tumor apparently originated in the hypothalamic region and had subsequently destroyed it. Histological studies proved the tumor to be an oligodendroglioma and to have undergone mucinous degeneration.

Eleven other cases reported in the literature in which an oligodendroglioma had become disseminated through the cerebrospinal fluid pathways, are discussed and furnish a basis for the opinion that oligodendrogliomas may be neither as localized nor as slow growing as is usually thought.

GEORGE PERRET, M.D.

Christensen, J. C.: Tumors of the Third Ventricle. Personal Experiences in 5 Cases. (Tumors del tercer ventrículo) *Bol. Soc. ciruj. Carab.*, 1945 4 286.

The author realizes that conclusions drawn by him from his experience in 5 cases cannot be generalized without a chance of error.

In one case the tumor of the third ventricle coexistent with an astroblastoma and tuberos

sclerosis, while in another with an isomorphous glioblastoma, a lymphangioma of the neck, and multiple nevi. An intracranial hypertension without major focal symptoms was characteristic for the entire series of 5 cases. In 3 patients paroxysmal attacks were due probably to a transitory blockade in the circulation of the cerebrospinal fluid either in the region of Monroe's foramen or in the cavity of the third ventricle.

The clinical examination revealed disturbances of the ocular motility, hypotonus, and binasal hemianopsia in all cases. Hypothalamic and mental symptoms were particularly marked in 1 case but were present to a lesser degree in other cases. In 1 patient a premature puberty and obesity appeared at an age younger than 10 years, immediately following the extirpation of the tumor. One patient developed a moderate obesity of adiposogenital character after the operation.

In 3 patients an exact diagnosis has been made on the basis of ventriculographic findings while in the remaining cases encephalography was employed.

In all cases the right transfrontal approach has been used. This type of approach is suitable for removal of all tumors of the third ventricle except those located in the posterior part.

Ventricular drainage according to Dott's technique should be employed if a considerable time elapses between ventriculography and the operation or if the surgical procedure is performed in two stages. The drainage should also be employed during and immediately after the operation.

Only 1 death could be attributed to the operation. The author considers operative results in tumors of the third ventricle as satisfactory. One year after the operation 3 patients were in a good condition while the fourth noticed a recurrence of the symptoms 3 months following the surgical intervention.

JOSEPH K. NARAY, M.D.

SPINAL CORD AND ITS COVERINGS

Rocca, E. D. and Valladares, H.: Injuries of the Spine (Traumatismos del raquis). *Arch. Soc. Cirujanos Hosp.* Santiago 1945 15 646

The authors report 85 cases of various spine injuries, reviews the mechanism of various lesions, and describes their symptomatology and treatment.

Dislocation occurs most frequently in the cervical region, mostly between the atlas and the axis or between the fifth and sixth cervical vertebrae. In the thoracic region a dislocation is observed most frequently between the eleventh and twelfth dorsal vertebrae between the latter and the first lumbar vertebra. Dislocations of the lumbar spine are rare on account of the firm fixation of the vertebrae.

Fracture-dislocation may be followed by a tear of the firm fixation of the vertebrae in the epidural space, the venous plexus located in the anterior lateral wall resulting hemorrhages on the anterior lateral or posterior aspect of the spinal cord. Blood may accumulate in the epidural, subdural or subarachnoid space and this may be followed by intraspinal

hemorrhage with a subsequent development of arachnoiditis. One of the authors' cases illustrates such a condition.

The most frequent site of fractures of the spinal apophysis is the thoracic or cervical portion of the spine.

A fracture of the vertebral arches involves the atlas or the axis in a great percentage of cases. Fractures of the vertebral body are caused nearly exclusively by an indirect trauma. In this type of fracture a medullary shock or concussion of the spinal cord is frequent and may produce a physiological section of the cord with a grave prognosis.

Fracture-dislocations of the spine are produced in a great percentage of cases by indirect trauma caused by a hyperflexion or hyperextension.

Injuries by missiles may sometimes create a picture of an anatomic section of the spine while in reality only a physiological section is present. The authors describe 1 such case in which a projectile produced an irreparable physiological section of the cord.

The degree of disintegration of the white or gray substance of the cord after a concussion depends on the intensity of the nutritional disturbances. This fact explains the appearance of medullary symptoms weeks or months after the trauma.

Medullary lesions may be situated at points distant from the site of trauma. For instance, 1 of the authors' patients sustained an injury of the dorsal region in his spine and yet the resulting myelomalacia involved the entire medullary tract. Hematomyelia or intramedullary hemorrhage, which may be produced by any type of trauma, affects the cervical portion more frequently than any other region of the spine. The original trauma may be transmitted through the column of the cerebrospinal fluid and cause hemorrhages in the gray substance at distant places.

Surgical intervention is indicated in the treatment of spinal injuries (1) if compression of the cord is demonstrated by the Queckenstedt test, stereoscopic roentgenograms, pneumospinalgrams, and myelograms, (2) if after a favorable evolution neurological symptoms of compression indicate that scar tissue is the responsible factor and (3) if symptoms of compression appear following orthopedic maneuvers.

The authors employ local anesthesia for intervention on the spine in all cases with very few exceptions. Tidal irrigation is recommended for the treatment of the cord bladder supplemented by the administration of sulfa drugs. The necessity of collaboration between orthopedic surgeon and neurologist is stressed.

JOSEPH K. NARAY, M.D.

Guthkelch A. N.: The Management of Recent Fracture Dislocations of the Cervical Spine. *Brit. M. J.*, 1945 2 880.

In fracture dislocations of the cervical spine with cord symptoms, Crotchfield tongs may be applied and the patient may then be nursed in the sitting

position. This is the main point set forth in the present article. Seven cases were treated in this way with satisfactory results. There were 4 deaths but these occurred in complete transverse lesions of the cervical cord and the lesions could be regarded as incompatible with life from the beginning.

The method is simple and can be applied anywhere. A stout post is lashed to the head of a bed and a pulley is fixed to it. The tongs are applied in a line slightly anterior to the pinna. A back rest is elevated until the patient is raised up to an angle of 60°. The tongs are weighted through the pulley with 18 pounds. Portable x-ray pictures are taken in half an hour and if there is no radiological change 4 pounds are added. X-ray pictures are taken every half hour and weight is added until the dislocation is reduced. When this happens, from 8 to 12 pounds of weight are applied and maintained for at least 3 weeks, then the weight is further reduced for 10 days and the patient is allowed up in a plaster cast.

The sitting position has several advantages: (1) gravity is used for traction; (2) the upward thrust of abdominal viscera is avoided and this is important in patients who have respiratory difficulties; and (3) the patient is able to look around, swallow properly and read. These factors promote better results than can be obtained in the usual lying position and they improve the morale of the patient.

ADRIAN VERBOOGHEM, M.D.

SYMPATHETIC NERVES

Wilson, H.: Thrombosis of the Brachial Artery Treated with Successive Cervical Sympathetic Blocks. *Am. J. Surg.* 1945 70: 255.

Blocking of the sympathetic chain is useful in the treatment of occlusive vascular disease, both of an acute and chronic nature. In thrombosis of a major vessel there is spastic contraction of the collateral channels which further decreases vascular supply to the part. Sympathetic block will relieve such spasm.

A case treated by such a procedure is presented. The patient was a 29 year old soldier whose right arm was pinned to the ground for 30 minutes as the result of an accident. He had a fracture of the left clavicle and contusions of the right chest wall and arm and of the face. The arterial pulse could be felt above the point where his arm had been pinned but not below. The right hand was cool and moist, the sensory and motor functions in the right arm were both greatly reduced. Since no hematoma was present, it was thought that the patient had a severe spasm of the right brachial artery. Three hours and twenty minutes after the accident a right cervical sympathetic block was performed with 1 per cent procaine. The results were inconclusive. Five successive blocks were performed at intervals of approximately 3 hours. The hand and arm were warmer after each block, but the effect usually disappeared in about 3 1/4 hours.

After 72 hours a weak radial pulse was felt, but this disappeared 3 days later. Sensation became

normal, but the patient had only 50 per cent use of the intrinsic hand muscles.

Four weeks after the injury the radial pulse was still absent so the diagnosis was changed to thrombosis of the brachial artery rather than spasm.

Procedures now in use in arterial injuries include ligation of a partially severed artery with its concomitant vein followed by sympathetic procaine block. Blakemore's suture method of bridging the arterial defects is occasionally used but a thrombosis or blowout may occur later. A procedure sometimes recommended is resection of part of an artery to interrupt the sympathetic supply distal to the resection. However sympathetic block is considered more complete. The author favors repeated procaine blocks rather than alcohol because of the occasional occurrence of complications such as aseptic neuritis which follows the use of the latter.

The deleterious effect of applying external heat to the affected extremity with the resultant increased oxygen demand is also stressed.

ROBERT E. GREEN, M.D.

MISCELLANEOUS

Wolf, G. A., Jr., Goodell, H., and Weiss, H. G.: Prognosis of Subarachnoid Hemorrhage. *J. Am. M. Ass.* 1945 129: 75.

In order to formulate a plan of management of patients with spontaneous subarachnoid hemorrhage the authors studied a group of 46 patients from the New York Hospital. The diagnosis of a subarachnoid hemorrhage was verified either by postmortem examination, operative visualization, or the finding of xanthochromic and bloody spinal fluid. There were no differences in sex distribution. The greatest number of cases occurred in the fifth decade, the cases being twice as common as at any other period.

Fifteen per cent of the patients had a previous history of migraine headaches, while 26 per cent had noted recurrent headaches. It was noted that the majority of patients were engaged in ordinary activity at the time of the rupture and a history of precipitating factors could not be elicited.

It was impossible to correlate the signs and symptoms with the prognosis—either immediate or late. It is of interest that many of the patients who had recovered had lost consciousness and had convulsions at the onset of the illness. Eleven postmortem examinations demonstrated aneurysms in 5 cases, but no demonstrable source of bleeding could be found in 6 of the cases.

By reviewing the current literature and their own series the authors promulgated the following percentages probabilities with the first episode of bleeding: 29 per cent of the patients entering the hospital die; 29 per cent die from recurrent bleeding between the second and fourth week, and another 5 per cent die within one year.

Based upon the previous probabilities and surgical mortality rates, an excellent management plan has been formulated.

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1 Within the first or second week the surgical risk of craniotomy is worth while if the general condition of the patient is satisfactory bleeding has stopped and the aneurysm has been verified by arteriography. If the arteriograms are negative the patient should be confined to bed for from 4 to 6 weeks. In Dandy's surgical series arteriography was not used.

2 If after a period of one month there are persistent or residual signs or symptoms arteriography should be done. Surgery would depend upon visualization of the aneurysm, its site, and the status of the patient's general and neurological condition.

3 If the patient has no signs or symptoms directly referable to the aneurysm after the first month arteriography and surgery are optional since the surgical mortality at the present time is higher than the mortality of conservative treatment. Migraine headaches, if present, should be carefully treated during the medical regime because of the possibility of further damage to the aneurysmal wall from repeated vasodilatations.

Jack I. Wooler M.D.
Kennedy F., Somberg H. M. and Goldberg B. R.: Arachnoiditis and Paralysis following Spinal Anesthesia. *J Am Med Ass* 1945 129 664.

The authors review many of the sequelae which have been reported following spinal anesthesia, and which involve the nervous system. These symptoms comprise stiffness of the neck, involvement of the cranial nerves (second third fourth sixth seventh eighth and twelfth) impaired bladder and rectal function hemiplegia and paraplegia degeneration of the pyramidal tract, meningoencephalitis, polioencephalitis, myelitis, myelopathy radiculitis,

severe neuritis septic and aseptic meningitis, arachnoiditis, neuritis of the cauda equina and other conditions.

One case is reported in which a middle aged female developed neurological symptoms approximately 6 weeks after spinal anesthesia which had been given in connection with a pelvic operation. The patient complained of numbness and weakness of the lower extremities pain in the back, which progressed upward into the shoulder girdle, and a subsequent development of radiating pain into the hand. Incontinence of the urine and feces appeared later. Studies of the spinal fluid revealed a partial block in the canal, with increased protein. A diagnosis of arachnoiditis, secondary to spinal anesthesia, was made, and a laminectomy performed.

Destructive arachnoiditis was demonstrated at about the twelfth thoracic segment. Some improvement followed surgery.

A second patient, a male of 50 was reported as having adhesive arachnoiditis following spinal anesthesia, which was localized at the conus medullaris. Slight improvement followed surgery but a major disability resulted.

A third patient, a male of 29 was paralyzed in the lower extremities three weeks after a spinal anesthesia, and laminectomy revealed adherent arachnoiditis extending from the fourth to the tenth thoracic spinal segment. Some improvement in the condition of the legs followed but a considerable degree of disability persisted.

The authors believe that a chemotoxic effect of the anesthesia plays a definite part in the production of such symptoms and this is true particularly if there is any pre-existing disease of the nervous system.

Howard A. Brown M.D.

SURGERY OF THE THORAX

CHEST WALL AND BREAST

Duany N P: Etiological Consideration concerning Cancer of the Breast (Consideraciones etiológicas sobre el Cáncer de la mama) *Arch C Bonas Cancer Habana*, 1945 4 121

Up to 1945 13 500 malignant tumors and 6 500 benign lesions were treated at the Radium Institute in Havana. One thousand and twenty three patients had tumors or other lesions of the breast, among them being 1 262 malignant and 463 benign tumors. Of 1 262 patients with malignant tumors, 1 248 were women, and of 463 patients with benign lesions, 457 were women. Among the benign lesions the following were observed in descending order of frequency fibroadenomas chronic mastitis or functional hyperplasia, cystic mastitis suppurative mastitis, papillomas, sebaceous cysts and gynecomastia.

Cancer of the breast was exceeded in frequency only by cancers of the uterus, oral cavity and skin.

Cancer of the breast occurred with greatest frequency in the sixth decade of life to be followed by the fourth fifth and eighth decades in which cancer occurred with approximately equal frequency. Then in descending order of frequency were the seventh, ninth, tenth, third, and second decades, other ages accounting only for a very small number of cases.

Seventy-eight per cent of the patients with cancer of the breast belonged to the white race 10 per cent were negroes, and 12 per cent were of mixed race. The entire population consists of 74.4 per cent of white people and 25.6 per cent of negroes and those of mixed blood.

In the author's material cancer of the breast occurred three times as often in multiparae as in nulliparae.

The relation between trauma and the development of sarcoma can be established much easier than that between trauma and the development of cancer.

In the author's material cancer was found in the patient's mother or father in only 1.1 per cent of the total. Apparently such antecedents are of no great importance.

The term mastitis, used by older pathologists apparently means nothing but hyperplasia gradually developing in women over 35 years of age. The term "mastitis" should be applied only to an inflammatory process. Evidence of such acute and chronic lesions was found by the author in only a small percentage of his material.

He concludes that apparently no relations of any importance exist between inflammatory processes and cancer of the breast.

A hereditary tendency toward cancer could not be definitely confirmed by the author's observations.

JOSEPH K. NARAT, M.D.

TRACHEA, LUNGS, AND PLEURA

Crafoord C., and Lindgren, A. G. H.: Mucous and Salivary Gland Tumors in the Bronchi and Trachea. *Acta chir scand*, 1945 93 421.

The authors' material of so-called bronchogenic adenomas comprises 14 cases, the tumors being located in the bronchi in 9 cases and to the trachea in 5 cases.

These adenomas were demonstrated to belong to the group of mucous and salivary gland tumors, and like such tumors in other locations, they may be classified as benign semimalignant (Klason, Rostvall) and malignant. Of this series, 7 were benign, 5 semimalignant, and 2 malignant.

The classification of the tumors in question as mucous and salivary gland tumors explains both the clinical course of the cases and the biological character of the tumors.

Tumors of this kind are generally benign, but sometimes they display signs of a certain local biological malignancy by producing inflammation and destruction and by causing metastases. However, the degree of malignancy generally appears to be low.

The authors believe that these tumors should be radically removed, if technically possible, as it is difficult to determine their malignancy or semimalignancy histologically in excised material. It is a known fact that so-called semimalignant mucous and salivary gland tumors can occasionally change to decidedly malignant tumors in the course of time.

Abbott, O. A., and De Oliveira, H. R.: Spontaneous Pneumothoraces Occurring in Patients Undergoing Peroral Endoscopy. *J. Thorac. Surg.* 1945 14 453.

There are many common complications of bronchoscopy such as the danger of direct injury to the bronchus and underlying vessels, the danger arising from local or general anesthesia, and the occurrence of subglottic edema. All too little attention has been paid to pneumothorax as a bronchoscopic hazard.

Kahler, Soulas, and Benjamin have reported instances of pneumothorax or subcutaneous emphysema following trauma to the bronchial tree which occurred while attempting the removal of foreign bodies. Here the mechanism of the leakage of air into the mediastinum is evident.

The authors are chiefly interested in the occurrence of pneumothorax following diagnostic peroral endoscopic examination. Examination of the literature revealed only 1 case similar to the cases reported in the authors' series.

Spontaneous pneumothorax most commonly is attributed to the rupture of a subpleural (subcutaneous) focus. Other causes are pneumococci, pulmonary gangrene, bronchiectasis, lung abscess, foreign body

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emphysema tumor congenital cysts, and pulmonary emphysema. Penetrating injuries to the chest wall or injury from within the bronchial tree by sharp objects or instruments obviously may produce pneumothorax.

Pneumothorax following bronchoscopy may be due to direct injury to the visceral pleura by the bronchoscopist. However as these patients have diseased lungs spontaneous pneumothorax may occur without endoscopic examination. Thoracic surgeons who use the bronchoscope on patients will most likely make periodic fluoroscopic examinations and discover unsuspected pneumothoraces. A majority of cases have sufficient pleural adhesions to minimize symptoms complicating the pneumothorax. This, unfortunately does not always occur and the complication may lead to dire results unless one is familiar with it.

The incidence of this complication is uncertain since routine fluoroscopies are not done following bronchoscopy. The authors 4 cases of pneumothorax following bronchoscopy occurred during a period of 12 months during which 537 bronchoscopic examinations were made on a surgical chest service for diagnosis or therapy. No bronchoscopic examinations were carried out for the removal of foreign bodies.

The authors present 6 case reports. In none of the patients was there any evidence of direct injury to the major bronchi. In 2 cases the pneumothoraces occurring coincident to bronchoscopy were asymptomatic and were accidentally discovered by fluoroscopy. In spite of the fact that both patients had suppurative lung disease, no empyema occurred. In 1 case the pneumothorax probably was due to the rupture of an emphysematous bleb since these are occasionally associated with patchy atelectasis in children. A similar etiology was suspected in an other case.

In the third case a pyopneumothorax developed secondary to rupture of a weakened necrotic area of a peripheral abscess. This is a spontaneous phenomenon which is likely to occur in these cases. It is a hazard of the coughing paroxysm subsequent to endoscopic manipulation rather than a complication of the procedure.

The fourth patient had advanced tuberculosis and far advanced pulmonary emphysema. Either or both etiological agents may have played a role during the postbronchoscopic coughing paroxysms.

The fifth patient had no postbronchoscopic pneumothorax, but died as a result of bronchoscopy and the associated coughing attacks. Possibly the explanation may be that in pulmonary emphysema, compression stenosis of the trachea may account for dyspnea with coughing attacks however the true explanation remains a mystery.

The sixth case described is rare and may be used to support Hammen's theory that spontaneous mediastinal emphysema may advance to the production of a pneumothorax. Two explanations have

stilled hands of connective tissue to the pleural surface of the lung which ruptures (2) the air in the mediastinum achieves sufficient tension to rupture the thin mediastinal wall into the pleural cavity. Most evidence seems to support the second route as the most likely.

Pneumothorax has many serious dangers attendant upon it and a consciousness of this complication in association with peroral endoscopy should prove lifesaving in some instances.

ROBERT R. BIGELOW, M.D.

Melick, D. W. and Spooner, M.: Experimental Hemothorax. *J. Thorac. Surg.* 1945 14 461

Experimental evidence is presented in support of the theory that blood coagulates normally in the pleural cavity. Blood introduced into the pleural cavities of dogs coagulates normally. Both the liquid portion of the blood and the clot are readily absorbed. The liquid portion disappears within from 10 to 14 days and the clot decreases in size to such an extent that it may be overlooked. After 2 weeks have elapsed little evidence remains to show that blood had previously been present in the pleural cavity.

The red cells are not laked immediately after introduction into the pleural cavity. They are recognizable after 5 days, although some are fragmented at that time. The fragmented erythrocytes are taken up by the macrophages, and appear as hemosiderin within the phagocyte.

The liquid portion of the blood will not clot, as it consists only of serum and cells, and will remain incoagulable indefinitely. Fibrinogen added to this liquid portion however will bring about coagulation. The pleura itself does not elaborate an anti coagulant.

SAMUEL KAHN, M.D.

Burford, T. H., and Burbank, B.: Traumatic Wet Lung. *J. Thorac. Surg.* 1945 14 415

In all wounds of the chest the lung tissue reacts to a greater or lesser degree according to the severity and type of the lesion, to produce more than its normal amount of interstitial and intra-alveolar fluid. The bronchopulmonary tree not only has more fluid of which to rid itself but also becomes less capable of doing this. The result of these factors may be called the "wet lung" of trauma. On the degree of "wetness" and on its recognition and treatment depends the outcome in many cases.

The primary phase of this syndrome finds the patient apprehensive. Dyspnea, accompanied by paroxysms of painful cough, is present. The cough however does not serve to empty the bronchopulmonary segments. On examination there is found restriction of motion of the involved side with diminished breath sounds. The outstanding feature is the presence of rales bilaterally but more marked on the affected side. In some instances the patient appears to be having a typical attack of bronchial asthma. In many cases the condition resembles non-traumatic pulmonary edema.

Recognition of the presence of "wet lung" should not detract from the importance of other lesions which may be present. The necessity for the proper treatment of these lesions must be stressed.

In treating "wet lung" the aim must be to control the production of moisture and to promote adequate bronchial drainage. Since pain originating in the traumatized thoracic cage structures, is the most important factor in the development of the unfavorable cycle of events, and since the pain interferes seriously with an effective cough mechanism the pain must first be combated. The use of morphine and adhesive strapping is physiologically unsound and ineffective. The use of procaine injections, either at the site of injury by intercostal nerve block, or by thoracic paravertebral sympathetic nerve block gives gratifying results which are often dramatic.

While the abolition of pain and the reinstitution of a painless, effective cough mechanism are essential, other forms of therapy are often also necessary. The bronchopulmonary tree may be flooded. The secretions should be mechanically evacuated by tracheobronchial catheter aspiration. In some cases, atropine given intravenously may be of value. In the more resistant cases, oxygen, delivered at a positive pressure of from 6 to 8 cm. of water is of benefit.

Traumatic "wet lung" must be differentiated from bronchial asthma, pulmonary edema of cardiac origin, pulmonary edema seen in peripheral vascular failure, and from blast lung. SAMUEL KAHN M.D.

McDonald, J. R., Moersch, H. J., and Tinney W. S.: Cylindroma of the Bronchus. *J. Thorac. Surg.* 945 14 445

Six cases of cylindroma of the lung are reported. The clinical course was remarkably similar to that of adenoma of the bronchus, with the exception that in 1 case the neoplasm involved the trachea. The bronchoscopic appearance of the tumor also was similar to that of adenoma of the lung. The lung which is the seat of a cylindroma grossly resembles that in which an adenoma is found in that bronchiectasis and lung abscess are common sequelae to the long-standing obstruction produced by the tumor. Cylindroma histologically presents a different appearance from that of adenoma of the bronchus and seems to be more closely allied to mixed tumors

Valle, A. R., and White M. L., Jr.: Penicillin in Pulmonary Resection. *J. Thorac. Surg.* 945 14 437

Pulmonary resection in recent years has become a refined surgical operation with a mortality which is comparable to that of the major abdominal procedures. This development is due to (1) increased knowledge of thoracic physiology and pathology (2) progress in anesthesia, (3) increased knowledge of shock and fluid and blood replacement, (4) increased knowledge of the surgical anatomy of the lungs, and (5) developments in chemotherapy

Chemotherapy, the most recent development, has contributed to the control of infection of the pneumonia, pleura, and chest wall. For the last 5 years the sulfonamides have controlled postoperative pneumonias and diminished pleural infections. The discovery of penicillin opens a new field in the control of postoperative pleural infections. White, Nicholson, and Stevenson, and D. Abreu, Litchfield, and Scott have all demonstrated the protective value of penicillin in controlling pleural infection. D. Abreu and his coworkers have shown that penicillin instilled in the pleural cavity is retained for as long as 3 days while, conversely its passage from the blood stream into the pleural cavity is slight. In a recent article Blades reported that the incidence of empyema in a penicillin-protected and control series was about the same.

In the present article, the authors compare its course and results in patients with pulmonary resection who were treated with and without the administration of penicillin. The authors discuss their technique of pulmonary resection and stress the problem of drainage and the method of using the penicillin.

Preoperatively for 2 or 3 days, 10,000 units of penicillin were given intramuscularly every 3 hours. This was usually continued postoperatively for 3 or 4 days, and over a period of 7 days in heavily contaminated cases. Fifty thousand units of penicillin in 10 c.c. of saline were injected into the pleural space through a catheter at the completion of the operation. For 6 or 7 days after operation, 50,000 units of penicillin were injected daily into the pleural space through the catheter or (after removal of the catheter) following thoracostomy.

This series consisted of 48 consecutive pulmonary resections carried out during a period of 31 months, the first 28 without penicillin, and the last 20 with penicillin therapy as described. The two groups were roughly similar as to diagnosis and operative procedure.

In group 1 (without penicillin) there were 25 lobectomies and 3 pneumonectomies. Of the lobectomies, 15 were for bronchiectasis, 4 for tuberculosis, 3 for lung abscess, and 3 for cystic disease. Two of the pneumonectomies were for carcinoma and 1 for sarcoma. Nineteen of the 23 cases (83%) involved some division of pulmonary tissue and were considered as contaminated.

In group 2 there were 15 lobectomies and 5 pneumonectomies. Of the pneumonectomies, 3 were for bronchiectasis, 1 for carcinoma, and 1 for tuberculosis. Of the 15 lobectomies, 11 were for bronchiectasis, 2 for tuberculosis, 1 for pulmonary cyst, and 1 for lung abscess. In 13 cases (86%) there was division of pulmonary tissue with grossly contaminated pleural spaces.

In group 1, two of the pneumonectomies were uncomplicated, the third patient developed a bronchial fistula with a fatal empyema. Bronchial fistulas developed in 10, or 40 per cent, of the patients who had undergone lobectomy. One patient

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with pneumonectomy and all patients with lobectomy developed empyema. Tubal drainage for an average of 12 weeks was required.

Of the pneumonectomies in group 2 all patients had uncomplicated recoveries. Of the lobectomies, none of the patients developed an empyema. fistula and only 1 patient developed an empyema.

Fourteen per cent, or 4, of the patients in group 1 developed chest wall infections while no case in group 2 was so complicated.

The patients in group 2 showed a marked decrease in days of hospitalization and an earlier day of rising after operation. The average febrile reaction was slightly less than that of the patients in group 1.

Aspiration of the chest in group 2 patients on the first postoperative day yielded from 400 to 500 c.c. of fluid. The quantity decreased rapidly and thoracentesis was seldom needed after the seventh day. Except for empyema in 1 case all cultures were negative. This was in marked contrast to the common empyemas in group 1.

Three of the patients in group 1 died—one of these (who had had a pneumonectomy) from an empyema due to a bronchial fistula, another as the result of a tuberculous pneumonia and the third patient, from a suppurative pericarditis secondary to a small basal empyema. One patient in group 2 died as the result of an extensive tuberculous spread.

The authors discuss in detail the single case of empyema in group 2 which represents a cure of empyema with penicillin, and without surgical drainage. An interesting case of lobectomy (group 2) in which pus was spilled into the pleural cavity is also discussed. Here in spite of extensive gross contamination no pleural or chest wall infection developed.

The authors attempt to show the advantage of using penicillin intrapleurally and intramuscularly in pulmonary resection without drainage of the space. They believe that the evidence points to prophylaxis of the pleural space from infection by penicillin. Blades reported that 11 of 29 patients who were treated with penicillin developed empyema. The difference between these figures and the authors' figure of 1 case in 20 probably can be explained by the fact that the authors do not drain the pleural space even for a few days therefore a high concentration of penicillin can be maintained by daily injections.

Successful bronchial closure is important, but it is not the only factor to be considered in the prevention of empyema. The authors believe that an empyema may contribute to the formation of a bronchial fistula. By maintaining pleural aseptals and maximal re-expansion of the remaining pulmonary tissue, the chances of bronchial fistula are lessened.

The clamped-off catheter of aspirating fluid during the 48 hours when the patient is most uncomfortable. Its advantages are that the penicillin concentration intrapleurally is kept as high as possible. Secondly it facilitates the re-expansion of the

remaining lung by the negative intrapleural pressures induced and maintained by fluid aspiration. Should an empyema develop it is apt to be small, and recovery rapid.

A striking demonstration of the value of penicillin is shown in the heavily contaminated cases in which lung tissue has been divided in the open pleura. Finally, the patient's postoperative course with penicillin, is smoother there is earlier rising and a shorter hospital stay. In a larger series of cases the mortality should be consistently lower since the dangers of putrid empyema and bronchial fistula are decreased with the use of penicillin.

ROBERT R. BICKLOW M.D.

Adams, W. E. Thornton T. F. Jr. and Carlton L. M. Jr.: The Use of Blood Plasma for Filling the Pleural Space following Total Pneumonectomy. *Ann. Surg.* 1945 122 905

In view of the results of experiments on a variety of animals Adams and his associates found it worth while to test the influence of filling the pleural space with plasma following total pneumonectomy in man. Eighteen patients received such treatment and 10 additional patients used as controls, received no plasma. The usual method of management consisted in the determination of the red cell count, hemoglobin value and plasma protein prior to operation. At the time of surgery between 500 c.c. and 600 c.c. of plasma were introduced into the pleural cavity at the closure of the thoracic wall and 200,000 units of penicillin were placed in the pleural space of 9 of the 18 patients.

Between 1 and 3 days after operation, following chest fluoroscopy the remainder of the residual air was removed and replaced with plasma usually amounting to from 200 to 400 cubic centimeters.

From the data presented and also from studies as yet unpublished, it was evident that the greatest drop in red cell count, hemoglobin and hematocrit readings occurred between the third and fifth day after surgery. Following this there was a slow return to normal but in most instances the preoperative plasma protein level had not been reached by the end of the 2 weeks following operation.

The lowering of blood plasma proteins was also greatest usually by the third to the fifth day but the fall did not always parallel that of the hemoglobin. In some patients the red cell count and hemoglobin remained at very nearly the preoperative level although the plasma proteins fell. When the proteins were lowered to from 1 to 2.5 gm. per cent they usually had not returned to the preoperative level by the end of 2 weeks following operation.

The average fall for 14 patients who received plasma in the pleural space was 0.90 gm. per cent. In contrast to this, the average fall for the control group was 1.48 gm. per cent or almost twice that of the treated patients. It was seen moreover that a high percentage of the treated patients had only a slight lowering of the plasma proteins and maintained a higher postoperative level than the controls.

The incidence of serious complications and the mortality rate were almost twice as great in the control group as in the group which received plasma in the pleural space following resection of the lung.

It is thought that although the series of patients is not large, the discrepancy between the two groups is significant.

A striking difference in the incidence of post operative empyema and bronchial fistula was seen between the methods of bronchial closures. Of the 12 patients in whom a s row suture technique was employed 4 developed an empyema, 3 of whom had a bronchial pleural fistula. In contrast with this, none of the 16 patients whose bronchial stump was closed by a single row suture technique developed either an empyema or fistula following operation.

STEPHEN A. ZIEGLER, M.D.

Delmas, J. E.: The Operative Treatment of Fistulous Empyemas following Pneumothorax (*Traitements opératoire de los empiemas fistulados postpneumotóraxicos*). *Rev. esp. cir. torac. bronq.* 1945 3: 270.

The author discusses the operative treatment of cutaneous fistulas complicating a spontaneous or therapeutic pneumothorax. He performed 7 thoracotomies on account of chronic empyema following pneumothorax. These cases did not include empyema following pleurisy or traumas of the chest. His material belongs to Hedblom's groups 2 and 4. Usually in such cases an encapsulated pleural cavity is found with the mediastinum and the corresponding lung retracted the pleura has lost its ability to expand, the ribs are practically in contact with one another and there is a corresponding deformity of the chest. Multiple fistulas with surrounding cutaneous ulcerations are present. As a rule the condition is complicated by myocardial degeneration and visceral amyloidosis.

As to the treatment, extrapleural thoracoplasty cannot always be carried out. To replace thoracotomy Kirschner suggested intrapleural methods after an anterior resection of the second and third ribs. In selected cases pleurectomy may be performed.

Schede's extensive thoracotomy is a very serious intervention which should be performed in stages. McDonald suggested a combination of intrapleural and extrapleural methods. Sauerbruch performs a paravertebral columnar thoracoplasty on the first to the ninth ribs in the first stage, in the second stage he removes completely the tenth and eleventh ribs and obliterates the empyema and in the third stage he performs a parasternal resection of the first to the eighth ribs.

The author modified Braun's procedure, which in turn is an improvement of the original Schede method. It is advisable to make the intervals between the various stages of the operation as short as possible to prevent degeneration of the thoracic wall. As a rule in the first stage a superior paravertebral resection of from 5 to 7 ribs is performed. In the

second stage a paravertebral columnar resection of the lower ribs is done and the intercostal spaces are resected. In the third stage the pleurectomy is done. Sometimes the first stage consists only of an anterior resection of the first to third ribs with corresponding cartilages. In the second stage a paravertebral resection of the first to fifth ribs is performed and the intercostal spaces are resected. In the third stage a paravertebral resection of the sixth to the eleventh rib is performed and the fourth stage consists of pleurectomy. Great care is taken to leave the drainage tube in place during the intervention because the alteration of the thoracic wall after rib resections makes the introduction of a drainage tube into the old fistula very difficult. The intervention can be done under local anesthesia supplemented by a costopleural bloc.

The author concludes from his studies that a fistulous empyema without retention of pus in a patient in a good general condition can be treated by drainage and aspiration. A residual cavity requires a limited pleurectomy. A rigid cavity with considerable pachypleuritis should be treated by pleurectomy according to the described technique. Pleurectomy should be preceded by an interruption of the intercostal nerves. If the cavity is small, a one stage limited pleurectomy should be performed.

JOSEPH K. HART, M.D.

HEART AND PERICARDIUM

Watts, T. D., and Toome, E. G.: Successful Removal of Foreign Bodies within the Pericardium. *Surgery* 1945 18: 685.

Inasmuch as the proper management of foreign bodies within the pericardial sac has remained indefinite the authors report a cases in which the patients were treated by successful surgical removal. One case of successful surgical removal has been reported previously.

It is not intended to recommend, from the experience with these 2 cases and the 1 previously reported, that all foreign bodies of the pericardium should be treated surgically. For the most part the question of surgical intervention lies with the clinical appraisal of each individual case by both the clinician and surgeon. The patient's symptoms, the objective evidence of pericardial or myocardial changes, and the possibility of future complications are to be balanced against the operative risk. Each of these points of evaluation are at present subject to wide variations in interpretation, and a clear cause-and-effect relationship of the symptoms, the signs, the pathology encountered, and the possible complications is lacking in most reports.

The presence of extensive and dense fibrous within the pericardium has been an outstanding finding in each case and probably is the underlying basis for the subjective complaints and the abnormal objective findings noted. As a result of this observation and especially as a result of the authors' experience with 1 patient the optimum time for re-

gical removal would seem to be as soon as the circulatory function becomes stable and the patient's general condition permits.

There were abnormal electrocardiographic findings in the case previously reported and in each of the cases in this report.

In the former these findings were interpreted as indicating myocardial damage because of the depth of the inversion of the T waves in Lead 4 and the failure of the patient to show improvement in the weeks of observation following operation. In the latter cases of this report the electrocardiographic changes were thought to be due to pericardial damage. In both instances the electrocardiogram showed a return to the normal configuration following the operation.

In addition to the immediate consequences of a foreign body within the pericardium subsequent developments of a serious nature may result. There is always the danger of infection arising at the local site of any foreign body particularly when organic material such as clothing is present, as is often the case in penetrating shell fragment and bullet wounds. The adjacent vital structures such as the heart chambers or the great vessels may be eroded or penetrated with serious or disastrous results.

JOHN E. KIRKPATRICK, M.D.

Max, F. H., Awad, S., and Pedraza, C.: Pericarditis (Pericarditis). *Rev Med Chile* 1945 73 833

Of 42 cases of pericarditis observed by the authors 20 were of rheumatic origin, 7 were tuberculous, 6 the cause could not be established and 2 followed septicemia, 2 anemia, 3 secondary pneumococcus infection, 1 primary pneumococcus infection, 20 cases were uremia and pneumococcus infection, 20 cases were acute and 13 chronic.

Of 20 cases of rheumatic pericarditis, 4 developed in the course of the first attack. Of the 20 cases 15 presented valvular lesions. In 11 patients an exudative pericarditis was diagnosed, in 4 a dry type, and in 1 patient a symphysis while in the remaining 4 cases the exact diagnosis could be established only at autopsy. The character of the exudate by autopsy in 15 cases by paracentesis in 2 patients by autopsy in 1 and by clinical and x ray examinations in 7. Of the first 4 cases, 2 had a hemorrhagic serofibrinous exudate, 1 case had a hemorrhage and 1 a sero-exudate, 1 case had a hemorrhage and 1 a sero-exudate.

Of 7 tuberculous cases, 6 had signs of polyserositis, 5 of them had an exudative pericarditis, and 1 had an adhesive form while the seventh case presented a partial constrictive chronic pericarditis.

Both uremic cases had a serofibrinous exudate. Of 3 patients with septicemia, 1 had a hemorrhagic serofibrinous and the other a fibrinopurulent exudate.

Of the 4 patients with pneumococcus, 1 patient had a primary form while 3 patients had had pneumonia. One patient had a fibrinopurulent exudate, the other a purulent, the third a serofibrinous, and the fourth a fibrinous exudate.

Of 29 patients with an acute pericarditis only 1 patient presented a picture of tamponade of the heart.

Of 13 patients with a chronic pericarditis, 3 showed signs of a chronic compression.

An elevation of the sedimentation rate was noticed in the majority of patients with the rheumatic form. They had anemia, neutrophil leucocytosis, and a deviation of the blood picture to the left.

The ages of the patients with the rheumatic form ranged from 13 to 40 years, that of patients with the tuberculous type from 11 to 25 years, while the age of those with the pneumococcal form ranged from 29 to 65 years.

Of 15 patients with pericarditis 8 showed electrocardiographic signs of an acute type, 6 those of a chronic type, and one patient had no pathological signs whatsoever.

Clinically the condition was characterized by the following signs: (1) cyanosis, (2) dyspnea, (3) venous hypertension, (4) arterial hypotension, (5) venous congestion of the neck and an inspiratory enlargement of the jugular veins, (6) edema of the lower extremities and in the receding position also of the chest and upper extremities, (7) paradoxical weak pulse and tachycardia as a compensatory phenomenon, (8) hepatomegaly and splenomegaly, (9) ascites, and (10) cardiac manifestations such as intensified third sound to the left of the sternum, small cardiac dullness, diastolic impulse, systolic depression and absence of the apical impulse.

Röntgenological findings are important in exudative but not in dry pericarditis.

JOSEPH K. NABAT, M.D.

Ivanovitch, O. and Martians, L. H.: Treatment of the Encased Heart. Chronic Constrictive Pericarditis (Tratamiento del corazón aprisionado). *La pericarditis crónica constrictiva*. *Boletín de la A. G. Cir.* B. Air, 1945 31 339.

The authors operated on 8 patients with chronic constrictive pericarditis. Three patients were cured, 1 patient showed marked improvement in his condition, 2 patients showed temporary improvement but death occurred later on and 2 patients succumbed to the operation.

An intervention should not be undertaken until the primary condition has passed its acute stage. This statement holds true particularly in cases of tuberculosis of the pericardium. Surgical intervention undertaken to free the heart during the evolutionary stage of tuberculosis has proved unsuccessful and caused death. The patient developed a bacillary meningitis and died from it. Tuberculous lesions were found in the extirpated pericardium. Patients with a marked passive cardiac deficiency should not be subjected to an operation.

Before the operation an attempt should be made to improve the patient's condition and the cardiac efficiency. Furthermore, serous effusions should be evacuated to prevent if possible a new formation of adhesions.

Blood transfusions should be given before the operation if necessary. Either local or general anesthesia, with cyclopropane or ether given through a tracheal tube can be used. Any approach with which the surgeon is familiar may be used. Extirpation of the pericardium should be as ample as possible. Total pericardectomy is not always possible on account of firm adhesions which are likely to exist in certain zones between the heart and the pericardium. In such cases which are relatively frequent a partial pericardectomy must be performed. Experience has shown that many patients have fully recovered after partial extirpation of the pericardium.

The authors obtained a cure in 37 per cent of their material. This figure compares favorably with that of other authors who show cures in from 22 to 36.6 per cent of their cases.

JOSEPH K. NARAY, M.D.

Shallard B.: Patent Ductus Arteriosus. *Med. J. Australia* 945 : 353.

The prognosis in patients with patent ductus arteriosus is poor apart from surgical treatment. Shallard reports in detail the cases of 14 patients on whom operations were performed. Four succumbed to operation: 3 from hemorrhage and 3 from other causes and 1 died from subsequent infective endocarditis.

In discussing the diagnosis it was thought that there is not one clinical sign which alone can be depended upon as being constant. The murmur described as continuous machinery water wheel, train-in-tunnel may not always be found. In 2 of the patients the murmur at the initial examination was limited strictly to systole. The diastolic component developed during a period of observation of 6 months in one patient and during a period of 3 years in another.

X-ray pictures are invaluable in diagnosis, but are not pathognomonic. Dilatation of the pulmonary artery was present in only two-thirds of the cases. Left ventricular hypertrophy was found radiologically and a deviation occurred in the electrocardiograms in 4 cases. Significant changes in the S-T intervals in two readings were observed.

Pallor, a clinical sign not hitherto described, is considered important, and anginal pain on effort was reported by 2 adult patients. These symptoms are unusual in patent ductus arteriosus.

STEPHEN A. ZIEGLER, M.D.

Paton C. N.: Anesthesia in Cases of Ligation of Patent Ductus Arteriosus. *Med. J. Australia* 945 : 361.

Basal narcosis with avertin, followed by inhalation anesthesia with cyclopropane was found to be a satisfactory form of anesthesia in a series of cases of ligation of a patent ductus arteriosus.

Cyclopropane was selected because of its non-toxic and nonlimiting features, the shallow type of respiration it produces, the ease with which con-

trolled respiration can be instituted, the low concentration of oxygen in which it is administered, and its reversibility. A standard McKesson machine was used which facilitated the application of accurately measured positive pressure.

Endotracheal intubation was an added advantage because a minimum of disturbance of cardiac and respiratory function was experienced. Complications either during or after operation were surprisingly few.

STEPHEN A. ZIEGLER, M.D.

Edye, B. T.: The Surgical Treatment of Patent Ductus Arteriosus. *Med. J. Australia*, 1905, 365.

Edye describes the procedure he employs in the surgical treatment of patent ductus arteriosus. He approaches the pathological condition through a planned space, verified by skiagrams to be opposite the second left intercostal area. An oblique incision over this intercostal space was made, coursing upwards and outwards in the direction of the fibres of the pectoralis major muscle from the margin of the sternum to the line of the anterior axillary fold. The muscle was split and not divided. In the older patients a curved incision was made with the convexity upwards to avoid the mammary tissue. The pleural cavity was entered by incision of the intercostal muscles and pleura, and the cartilage of the second and third ribs were divided. The lateral mammary artery was sometimes divided between ligatures, but at other times the incision stopped short of it. If it was injured it caused troublesome hemorrhage and delay. A rib spreader was inserted over gauze sponges and the wound was widely opened. A light gauze pack was inserted to prevent the collapsed lung. The diagnosis was confirmed by the characteristic thrill detected on palpation at or near the site of the ductus. Usually the anatomical structures including the phrenic and vagus nerves and the left subclavian artery were clearly visible. The ductus joins the aortic arch at or just beyond the level of the origin of the latter. This preliminary examination completed the mediastinal pleura was divided vertically between the 2 nerves. The posterior leaf was raised to bring into view the recurrent nerve which hooks around the aorta immediately to the left of the ductus, and is a most important guide to the latter. The ductus was located by making pressure over the interval between the aortic arch and the pulmonary artery at various points until the thrill was obliterated.

The dissection of the ductus was a tedious process, fraught with considerable anxiety for its end was apt to be delicate and easily torn. The interval between the aortic arch and the pulmonary artery was gently widened by blunt dissection with key curved forceps a little distance to the right of the ductus, and the process was repeated closer to the ductus until that aspect was freed. A smaller dissection was carried out on the opposite side, the left recurrent laryngeal nerve being used as a guide. The forceps was then insinuated posteriorly so as gradually

ally to open the interval between the ductus and the left bronchus behind. It was during this stage of the dissection that the ductus was apt to be torn. The maneuver was assisted by counter pressure with the left index finger in the interval between the aortic arch and the pulmonary artery to the right of the ductus. Narrow malleable copper retractors were a useful aid in the exposure of the ductus.

The next step was the passage of a MacCormick dissector behind the ductus aided as before by counter pressure with the left index finger care had to be taken not to catch the posterior aspect of the ductus with the instrument. When the dissector had been passed no attempt was made as a rule to free the ductus any further posteriorly, but the dissector now loaded with number 8 silk, was passed and the ligature was drawn through. The ligature slipped through with greater ease when the dissector was *in situ*. A second ligature was compressed digitally about this stage the ductus was compressed digitally and the effect on the circulation was noted. If after 1 or 2 minutes there were no untoward effects, the ligatures were carefully but firmly tied. By palpation and by auscultation with a sterilized stethoscope, it was determined that the thrill and murmur had disappeared. The incision in the mediastinal pleura was sutured as well as possible. Any blood was aspirated from the pleural cavity and the chest wall was closed in layers. The divided costal cartilages sometimes were and sometimes were not sutured with catgut. The ribs were drawn together with sharp hooks during the closure of the pleural cavity and the lung was encouraged to expand by the anesthetist and also by suction of air from the pleural cavity before final closure. No drainage was provided convalescence was usually uneventful, and only on occasion was it necessary to aspirate pleural fluid. The blood transfusion was continued slowly throughout the operation.

It must be remembered that when cardiac efficiency has been impaired it is possible the introduction of a large amount of blood may be detrimental.

STEPHEN A. ZEEMAN, M.D.

Groom, R. E.: Surgical Relief for Tracheal Obstruction from a Vascular Ring. *N. England J. M.* 1945 233 386.

In an infant with symptoms of tracheal obstruction (crowing inspiration, dyspnea, intercostal and suprasternal respiratory retraction) there developed attacks of superimposed tracheitis, for which the patient was hospitalized on 4 different occasions. Fluoroscopic studies made after the patient had a swallow of barium showed what appeared to be a mass lying behind the esophagus, opposite the third and fourth thoracic vertebra, with the esophagus itself pushed forward and narrowed in both the anteroposterior and lateral views. Instillation of the lipiodol showed a fairly marked narrowing of the trachea just above its bifurcation at a level corresponding with the previously described esophageal deformity. This narrowing was apparent in the

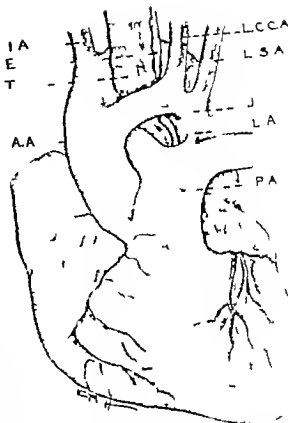


Fig 1 Arrangements of the great vessels as found at operation. The ascending aorta bifurcates into two branches one passes behind the esophagus and the other arches in front of the trachea. The two branches join to form the descending aorta. Within the vascular ring the esophagus and trachea are compressed. AA—ascending aorta; E—esophagus; IA—innominate artery; J—junction of the two aortic arches; LA—ligamentum arteriosum; LCCA—left common carotid artery; LSA—left subclavian artery; PA—pulmonary artery and T—trachea.

anteroposterior view and was particularly noticeable in the lateral film.

Operation was then performed at once, although the patient was in a precarious state at the time. Under cyclopropane anesthesia the chest was opened through a left anterolateral incision and the pleural cavity was entered through the third interspace with separation of the third and fourth costal cartilages. The left pleural cavity was traversed to reach the mediastinal structures. When the mediastinal pleura was opened the aorta was seen to divide into two vessels which enclosed and greatly constricted the esophagus and trachea and then joined to form the descending aorta. The left common carotid and left subclavian arteries came off the smaller anterior segment of the ring in the usual manner for the aortic arch and the much larger posterior segment gave issue to the innominate artery.

First the ligamentum arteriosum was divided between silk ligatures to allow the pulmonary artery to fall forward and away from the trachea. This procedure did not have a marked beneficial effect on the

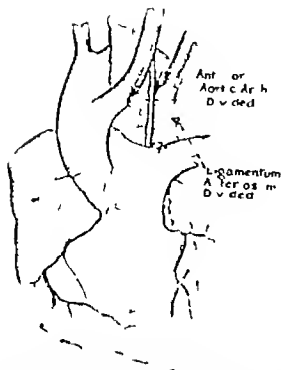


Fig. Surgical procedure. The ligamentum arteriosum was divided to allow the pulmonary artery to displace forward. The anterior arch of the aorta was divided to relieve compression of the trachea.

respiratory exchange and the anterior segment of the ring was then divided between the two branches which were described.

As soon as the anterior aortic arch had been divided the respirations quieted down, most of the crowing disappeared and the respiratory shift in the mediastinum diminished to a normal degree. The chest wall was closed in an appropriate manner, the left lung being completely expanded before final repair of the wound and the patient was placed in a steam room and given sulfadiazine and penicillin parenterally.

After 1 week the patient was alert and playful and had no distress of any kind. When the ear was held close to the chest a faint inspiratory sound could be heard during and immediately following deglutition of food these inspiratory sounds became slightly louder, apparently because the esophagus was still displaced forward by the aortic arch behind it and was causing some pressure on the posterior wall of the trachea.

Röntgenographic examinations 3 months later showed no change in the esophagus, and the trachea still presented some narrowing above its bifurcation but this was distinctly less marked. Although its left border had straightened out considerably there was some indentation along its right side, perhaps due to some residual pressure from the left common carotid artery which was now passing across the trachea from in front, or due to incomplete develop-

ment of the tracheal ring following the longstanding external pressure.

Vascular rings of this nature do not always give rise to important clinical symptoms, but when the compression of the trachea is great enough to give rise to respiratory distress, surgical division of some portion of the ring should offer an excellent chance for relief of the symptoms.

JOHN IV. BARNES, M.D.

ESOPHAOGUS AND MEDIASTINUM

Lam, C. R.: Surgical Treatment of Congenital Atresia of the Esophagus. *J. Pediatr. S. Soc.* 1945 27:456

Until Leven in 1939 reported that a child had survived the serious preliminary operations of a multiple stage procedure for congenital stenosis of the esophagus, and that if an antethoracic skin tube could be constructed the case could be called successful the outlook for the child born with an obstructive defect in the esophagus was hopeful.

The indirect method, however, had many disadvantages and it soon gave way to the operation of direct anastomosis.

Esophageal atresias may be classified as follows: type 1 in which there is complete absence of the esophagus (rare); type 2 in which there is an upper and a lower segment ending in blind pouches (also rare); type 3 in which one or both of the segments communicate with the trachea or bronchus. Type 1 is subdivided into type 3a, in which the fistula is between the upper segment and the trachea, type 3b, in which the fistula is between the lower segment and the trachea, and type 3c, in which both segments communicate. Type 3b is encountered more frequently than all other types combined and accounts for from 80 to 90 per cent of all congenital atresias of the esophagus.

If a newborn infant has a tendency to choke on its own mucus or is unable to take feedings, reliable roentgen studies should be carried out and if a congenital lesion is present, its type can be determined with considerable certainty.

For a successful operation, three objectives are in order: (1) provision must be made for feeding the infant; (2) regurgitation from the stomach through the lower segment into the trachea and bronchial tree must be prevented; (3) the blind pouch of the upper segment must be opened to allow the escape of swallowed saliva. These requirements would be met by gastrostomy, ligation of the lower esophageal segment and marsupialization of the upper pouch. With these three procedures completed, the situation would be compatible with life, but permanent gastrostomy feedings would be necessary unless an antethoracic esophagus could be constructed. On the other hand, the operation of direct anastomosis meets at once all the essentials for the establishment of normal functional and anatomic conditions.

Most or all of the operation is performed under local anesthesia. A transfusion of approximately 15

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c.c. of blood is given through a cannula inserted in an ankle vein. Access to the posterior mediastinum is gained by exposure of the vertebral ends of the second through the sixth ribs, subperiosteal resection of short lengths of these ribs, section of the third, fourth and fifth intercostal bundles, and careful reflection of the parietal pleura from the vertebral column. It is necessary to ligate the azygos vein on the right or the upper two or three intercostal arteries on the left, to open up the space behind the trachea where search will be made for the distal segment. The upper segment is identified by the palpation of a catheter which has been introduced through the mouth. The lower segment is then located and ligated as close to the ligature as possible. It is cut transversely distal to the ligature and a corresponding opening is made in the blind upper segment. End-to-end anastomosis is performed over a catheter and with the use of fine silk suture or eye needles. If no distal segment can be found or if after ligation the segment is too short to be connected with the upper one, resort to an indirect method is made.

Immediate postoperative care consists in an oxygen tent incubator, extreme vigilance in the aspiration of secretions from the pharynx and nothing by mouth for 5 days. Parenteral fluids being administered by hypodermoclysis. On the fifth day, if inspection of the dressing shows no leakage of mucus from the wound, cautious feeding by mouth is begun. One-half ounce of 5 per cent dextrose solution is offered every two hours. If there is no regurgitation or evidence that the anastomosis is not intact this amount is gradually increased to 1 ounce. On the seventh postoperative day 1 ounce of formula is given every 3 hours. If this is tolerated all restrictions on the feeding of formula are removed after the tenth day. Vomiting should be avoided for it would undoubtedly put strain on the anastomosis.

STEPHEN A. ZIEGLER, M.D.

Scott W. J. M.: Idiopathic Dilatation of the Esophagus. *Ann Surg* 945:131-138.

Today it is recognized that dilatation of the esophagus without obvious pathological cause is a common condition. In fact it is approximately one third as frequent as carcinoma of the esophagus, being second only to the latter in the statistics of the larger clinics (MacMillan). It appeared earlier in the literature under the purely descriptive term, ectasia or idiopathic dilatation of the esophagus. But today the author's etiological conception is usually introduced into the name, and the condition is most commonly designated as achalasia of the cardia or cardiospasm although there are still widely conflicting opinions about the cause of the dilatation.

Fortunately for the patients who suffer from this serious and usually progressive difficulty in the passage of food from the dilated esophagus into the stomach, treatment does not need to wait for a final determination of the cause by dilatation of the

cardia, either on one or repeated occasions, the symptoms in the majority of cases are adequately controlled. However some of these patients do not respond satisfactorily to this and the other conservative measures of treatment. Although the percentage of this refractory group is small, the failure to respond to conservative measures offers a serious problem for two reasons: first, because of the complete failure of the usual therapeutic measures to alleviate the condition and, second, because of the progressive seriousness of the symptoms. These cases constitute a small but important group and their relief has become a challenge to the general surgeon as well as to the esophagoscopist.

Dilatation of the esophagus without any clinically discoverable obstruction is not a disease entity but a syndrome. At least four clinical types can be recognized each with a different etiology, namely: (1) achalasia of the esophagus, (2) true cardiospasm, (3) partial constriction near the cardia, and (4) dolichoesophagus.

Achalasia is probably the most common type. It usually responds well to dilatation. In true cardiospasm the reflex originating focus should be discovered and removed. Those cases caused by a covered and removed partial constricting band near the cardia are few in number but are probably resistant to conservative treatment. Dolichoesophagus, an S-shaped lengthening with pooling of esophageal contents at different levels, should probably be operated upon immediately on recognition. This type is very difficult to control when the dilatation becomes gigantic and is complicated by infection of the esophageal wall.

Subdiaphragmatic esophagostomy of the Finney pyloroplasty type appears to be the operation of choice in the cases of idiopathic dilatation of the esophagus that are resistant to the usual conservative measures. The symptomatic results of this operation are usually excellent whether or not the dilatation of the esophagus is entirely corrected. The danger of the operation is not excessive when proper precautions are taken. After this operation has been employed more extensively the number of cases in which it is indicated will probably be considered as having increased but it should never replace conservative dilatation in the majority of cases.

JOHN E. KIRKLAND, M.D.

Olsen A. M., O'Leary P. A. and Kirklin B. R.: Esophageal Lesions Associated with Acrodermatitis and Scleroderma. *Arch. Int. M.* 1945, 76:189.

Approximately 10 per cent of the patients suffering from acrodermatitis or scleroderma made complaints referable to the esophagus. The most common complaint was dysphagia. Frequently there was also subcutaneous burning after meals, especially when the patient was lying down. Positive roentgenographic or endoscopic findings were demonstrated in 18 cases. Dilatation of the esophagus similar to that seen in cardiospasm was

observed in 7 cases and hiatal hernia with intra thoracic stomach was demonstrated in 9 cases. In 2 other cases sclerodermic changes were demonstrated in the esophageal wall.

Acrosclerosis should be distinguished from other forms of scleroderma. In acrosclerosis the phenomena of Raynaud's disease are present prior to the dermatological changes or coincident with them. Thirty three of the 36 patients who had esophageal symptoms presented the clinical syndrome of acrosclerosis. All of the 18 patients who had positive roentgenographic or endoscopic findings had acrosclerosis.

The basic alteration in acrosclerosis and scleroderma is sclerosis of the connective tissues of the body. Sclerodermic changes in the connective tissues of the esophagus are chiefly responsible for the esophageal disturbances. It should be emphasized that esophageal disturbances are extremely uncommon in Raynaud's disease per se. Reduced or absent muscular activity in the wall of the esophagus and shortening of the esophagus apparently result from sclerodermic involvement. Disturbances of the autonomic nervous system may play some part in the causation. Clinical diagnoses of cardiospasm and hiatal hernia of the short esophagus type are made most frequently in these cases. Stenosis of the lower part of the esophagus and the esophagogastric junction may occur with hiatal hernia as the result of chronic inflammation of the lower part of the esophagus. This inflammation is the result of incompetence of the cardiac sphincter with regurgitation of the gastric secretions.

The treatment of the esophageal lesions of acrosclerosis consists of the passage of sounds over a previously swallowed thread. Fairly satisfactory results have been obtained. The esophageal stenosis of 1 of these patients was treated satisfactorily over a 16 year period by repeated dilatations.

Clark, D. E. and Adams, W. E.: Trans thoracic Esophagogastronomy for Benign Strictures of the Lower Esophagus. *Ann. Surg.* 1945 2 943

Clark and Adams report in detail 5 cases of trans thoracic esophagogastronomy for benign stricture of the lower esophagus. None of the 5 patients was considered to have cardiospasm. In 1 case the stricture followed the ingestion of lye, in another it was associated with generalized scleroderma, and in 3 cases there was no etiological factor that could be ascertained. In all of the cases however the obstruction either started above the diaphragm, or the entire lesion was in the thorax, so that transabdominal cardioplasty was out of the question.

Four of the patients had repeated dilatations with only temporary relief and 3 of these required gastrostomies when dilatations became impossible. The fifth patient because a malignancy of the cardia was suspected was not subjected to dilatation.

Employing positive pressure ethylene-oxygen-ether anesthesia the authors opened the chest through the eighth rib bed in 4 cases, and through

the eighth interspace in 1 case. After proper retraction of the lung and excision of the phrenic nerve, the diaphragm was incised from the periphery toward the esophageal hiatus. The spleen was removed to facilitate mobilization of the stomach and the fundus was brought up into the thorax in the arch of the aorta. The anastomosis spot was selected just above or at the upper level of the stricture and side to side anastomosis was made. The diaphragm was closed about the stomach and sutured to its wall. The wound was closed tightly.

All of the patients made an uneventful recovery and are still alive and enjoying a normal existence.

It is concluded from these selected cases of benign stricture of the lower esophagus that trans thoracic esophagogastronomy offers the patient complete relief without the necessity of dilatation or the unpleasantness of the gastrostomy.

STANLEY A. ZIMMER, M.D.

MISCELLANEOUS

Donovan, E. J.: Congenital Diaphragmatic Hernia. *Ann. Surg.* 1945 122 566.

In reviewing the literature of the past 10 years in congenital diaphragmatic hernia, one is impressed by the number of single cases reported by various authors as well as by the series of cases reported by Harrington, Ladd and Gross, and Hartel, and Truesdel. Many of the infants were operated upon successfully at an early age. It is obvious from these reports that the diagnosis is made much earlier and that operative treatment has made great progress in recent years. In 1935 Hedblom reported that 75 per cent of the infants with congenital hernia die before they are 1 month old. In 1938, the author reported 10 cases from the Babies Hospital, New York, 6 of which had been operated upon. The purpose of this article is to review the surgically treated cases of the first series, add to their follow up, and report 11 additional cases operated upon since 1941.

The most common congenital defects in the diaphragm are, in order of their occurrence: (1) esophageal hiatus, (2) foramen of Bochdalek, (3) foramen of Morgagni, and (4) defects in the dome. Hernias through the vena caval or aortic openings in the diaphragm have never been reported.

The symptoms of diaphragmatic hernia may be either circulatory, respiratory, gastrointestinal, or a combination of all three. They are due to mechanical interference with the function of the herniated structures or to interference with respiratory or circulatory organs upon which the herniated structures encroach. In most of the cases of hernia through the foramen of Bochdalek, the usual finding is that the chest is full of intestines, both large and small, often accompanied by part of the stomach and quite frequently by the spleen and kidney.

Surgical repair of the hernia should be advised immediately for all cases in which either the small or large intestine is in the chest because of the danger of intestinal obstruction. The author prefers the

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abdominal approach through a subcostal incision with exposure of the phrenic nerve in the neck 48 hours before repair. Many surgeons prefer the thoracic approach. As a rule there are no adhesions in the chest and the structures are easily reduced if the operator places a retractor in the diaphragmatic defect and equalizes the pressure in the chest and abdomen before he tries to reduce the structures.

In 3 cases of this series there was a large opening with no attachment of the diaphragm to the posterior chest—these were probably cases of deficiency of or chest—these were probably cases of deficiency of the diaphragm. In these cases a row of silk sutures was used with two needles on each. They were passed through the diaphragm to the outside of the chest wall, one on either side of the adjacent rib and tied over a piece of gauze. Because of the deficiency of reparative material in these cases, the row of sutures attached the diaphragm at a higher level in the chest than normal in closing the defect. A second row of continuous or interrupted silk sutures were then used to attach the edge of the diaphragm to the pleura and intercostal muscle. In any type of closure a catheter is placed in the chest and the air is removed before the last suture is tied.

Positive pressure or intratracheal anesthesia are very desirable. All patients should be kept in an oxygen tent for several days after operation. Pleural effusion may occur and aspiration should be done as necessary. JOHN E. KIRKPATRICK, M.D.

Greer, A.: Two Cases of Mediastinitis Caused by Perforation of the Esophagus and Treatment with Penicillin. Recovery. (Dos casos de mediastinitis por perforación esofágica. Tratados con penicilina. Curación.) *Rev med Chile* 1945 73 979 *Rev otorinolaringol* 1945 5 115

The customary treatment of mediastinitis caused by perforation of the esophagus consists of mediastinotomy especially if the perforation is located in the upper esophagus, while a partial resection may be indicated in grave cases.

A perforation of the esophagus may be due to a voluminous foreign body or one with irregular surfaces or sharp points. In other cases a cancer or ulcer of the esophagus may lead to a perforation or the latter may be due to a traumatism in the course of esophagoscopy. A violent spasm provoked by an attempt to extract a large foreign body through an esophagoscope may be followed by a perforation.

If a perforation occurs in the cervical portion of the esophagus pain develops at the base of the neck and a subcutaneous emphysema appears. If the perforation involves the thoracic portion of the esophagus the pain is confined chiefly to the region between the scapulae, and the respiratory movements become shallow because deep respiration causes pain. If the perforation occurs in the distal portion of the esophagus the pain is confined mostly to the epigastric region. Anxiety, pallor of the skin and visible mucous membranes, frequent pulse, and the presence of anaerobic bacteria in the sputum and fever are other important signs.

The author treated an 18 year old girl who developed dysphagia following the ingestion of 10 c.c. of nitric acid. Two months later roentgenograms showed a cicatricial stenosis of the esophagus of caustic origin. The entire esophagus was rigid and stenosed. On esophagoscopy examination a stenosis was encountered at the upper aperture, and sounds, from size 12 to 18 were introduced through Jack's tube. The patient's condition improved but she returned 9 months later with intensive dysphagia. Sounds from size 12 to 14 would pass only the upper portion of the esophagus and roentgenographic studies confirmed the diagnosis of a high stricture. Dilatations of the esophagus were continued for 11 days. Two weeks later the patient returned with a more intensive dysphagia and edema and pains in the left side of her chest. The pains were radiating toward the left upper extremity and the left side of the spine. Gastrostomy was planned in order to facilitate alimentation. X-ray studies revealed a homogeneous, sharply circumscribed shadow in the upper mediastinum especially on the left side. The esophagus in that region had irregular outlines and a retention of barium was noticed 24 hours after its ingestion. The roentgenological diagnosis was mediastinal abscess of esophageal origin with a suspicion of pulmonary abscess on the left side. Twenty thousand units of penicillin were given every 3 hours in addition to a blood transfusion. The temperature returned to a normal level after 48 hours and the pain disappeared completely after the administration of 1,000,000 units of penicillin. Five days later x-ray studies showed a complete disappearance of the mediastinal lesion. It was believed that this lesion might also have been of tuberculous origin.

The second patient, 33 years of age had been complaining of epigastric pains and complete dysphagia for 4 years. The attacks used to come in the form of crises during which the patient was not able to swallow even his saliva. Gradually the attacks returned at shorter intervals so that at the time of admission hardly a day was passed without attacks. Roentgenographic studies revealed a contraction of the esophagus at the junction with the cardia. An esophagoscope 7 by 45 could not pass the stenosis. A dysfunction of the diaphragmatic hiatus with a resulting spastic condition of the esophagus was diagnosed and a mercury sound was passed. The procedure was repeated for 4 days. When the esophagoscopy examination was repeated a constricture was encountered at the cricopharyngeal level. The esophagoscope was withdrawn but in spite of careful technique the patient developed pain in the neck, especially on the left side. Frequent pulse, and a rise in temperature. Roentgenographic examination disclosed a sharply circumscribed homogeneous shadow in the upper mediastinum. The clinical and roentgenological diagnoses were mediastinitis due to a perforation of the esophagus. Thirty thousand units of penicillin were given intramuscularly every 3 hours, in addition to a hypodermic

moclysis of glucose in saline solution. The follow ing day an edema developed in the left lower cervical region and the frequency of respirations rose to 30 per minute. The pain was radiating to the left side of the chest and the left supraclavicular region. Only after 72 hours the fever, pains, dyspnea and other symptoms began to subside and it disappeared completely 10 days from the time the treatment had been instituted. The total amount of penicillin given was 1,020,000 units. A gastrostomy was performed to facilitate the administration of food and retrograde dilatation.

The author stresses the point that in spite of a large experience of the esophagoscopist and extreme care, fissures of the esophageal wall may follow dilatation of the esophagus. A necrosis of the mucosa gradually leads to the formation of a fistula with resulting mediastinitis. Blood transfusions and the administration of other fluids intravenously should supplement the administration of penicillin in such cases.

JOSEPH K. ARAT, M.D.

Forsee, J. H.: The Use and Control of Thoracic Surgical Teams of an Auxiliary Surgical Group. *J. Thorac. Surg.* 1945 14 495.

An auxiliary surgical group composed of a group headquarters, general surgical, orthopedic, neurosurgical, maxillofacial, thoracic surgical, shock gas, and dental prosthetic teams has been employed in the American Army for the first time during World War II.

This organization under one central control group has produced a maximum level of competence and economy in the deployments of specialized surgical talent. Remarkable advances have been made in thoracic surgery since World War I and thoracic surgical teams have been used for the first time in this war. The author's study is based on 15 months of experience caring for 3000 patients with thoracic injuries.

Thoracic surgical teams are composed of a thoracic surgeon, an assistant surgeon, an anesthetist, a surgical operating room nurse, and 2 enlisted surgical technicians. The chief surgeon should be a competent operator preferably with a sound basic training in general surgery, a good teacher and should have a thorough knowledge of surgical physiology of the thorax. The assistant surgeon should have a minimum of 2 years of surgical training with some experience in the medical aspects of thoracic diseases. The anesthetist should be expert in endotracheal and positive pressure anesthesia. In bronchoscopic aspiration of secretions, the management of shock, and in the recognition and treatment of disturbed cardiorespiratory physiology. The nurse should be an able instructor in operating room technique, able to teach the principles of asepsis to soldiers without previous experience, and have a knowledge of the technical features of the specialty. All team members should be sincere, have physical stamina, and the ability to adapt themselves to varied and changing situations.

The teams work in many different hospitals to supplement the regular staffs when the requirements for surgery exceed the capacity of the regular staff.

The equipment is minimal and consists of the army basic instrument set, and a supplemental thoracic set including a bronchoscope and accessories. An electric suction apparatus and portable anesthesia equipment complete the list.

The thoracic surgical teams are employed in forward and base section areas. The most severely wounded those who cannot be transported further to the rear without surgery are cared for in a phase of a small field hospital. Ordinarily a field hospital can care for 380 patients, but when used as a first priority mobile surgical hospital, the cases must be reduced to about 35. The small staff is supplemented when necessary by the qualified personnel of the surgical teams of an auxiliary surgical group.

It is here that surgical care can be first initiated. These hospitals are located in the rear of a division area and in close conjunction with a division clearing station. The platoons of a field hospital are capable of moving on short notice and they "leap frog" one another. The platoon, or part of it, is held behind and becomes a holding unit. When all the patients have been evacuated, in from 1 to 10 min the unit is available to "leap frog" another platoon and become the forward hospital.

An active platoon requires 4 general surgical, 1 thoracic, and 1 shock team. The thoracic surgical team not only operates but also advises in the management of thoracic wounds and teaches bronchoscopy to anesthetists and surgeons. The thoracic surgeon is interested in intercostal nerve block, pre and postoperative thoracentesis, endotracheal and positive pressure anesthesia, pulmonary resection after surgery, catheter aspiration of tracheobronchial secretions, the management of hemothorax, foreign bodies, and traumatic hemothorax has been a stimulus to all surgeons treating severe thoracic wounds.

Certain types of cases which were considered first priority surgical problems, in the light of certain therapeutic measures previously enumerated together with judicious shock management, are now frequently transportable, and immediate surgery is no longer considered necessary. One thoracic surgical team, however, during a period of 7 weeks, operated on 92 intrathoracic conditions, of which 16 were combined thoracoabdominal wounds, 16 were thoracotomies and 56 were penetrating or perforating injuries. At the same time this group operated on 44 patients with abdominal wounds.

First priority surgical cases represent only 3 per cent of the total cases arriving at the division clearing station. The majority are evacuated to the evacuation hospital a few miles to the rear. The mortality rate in a well run first priority hospital is about 25 per cent, and anything less usually indicates an improper selection of cases.

The overall mortality rate in 346 intra-abdominal wounds (20 per cent of which were combined thoracic

thoracoabdominal wounds) treated by surgeons of this group was 30.6 per cent. Pulmonary complications caused 27 per cent of the deaths, while peritonitis was responsible for only 11.4 per cent. Another series of 226 intrathoracic wounds with 43 per cent thoracoabdominal injuries showed an overall mortality of 28 per cent.

These figures indicate that most patients were wounded with high explosive shells, and that the highest percentage had multiple major wounds. Thoracic surgical teams working at this level must be competent to do major abdominal surgery.

The surgical teams of an auxiliary surgical group have done much to develop the phase of forward surgery. They have exerted a remarkably favorable influence on the morale of combat troops and have eliminated the temptation for clearing and collecting companies to indulge in heroic surgical procedures which they were never designed or equipped to carry out.

The evacuation hospitals, located from 3 to 15 miles in the rear of a first priority surgical hospital, treat 90 per cent of the casualties from the divisional clearing stations. The percentage of abdominal and combined thoracoabdominal injuries treated here is low, but a majority of the penetrating injuries of the thorax are treated here. An appreciable segregation of cases into the surgical specialties is practical. In such 400 or 750 bed installations, thoracic surgical teams have been useful to supplement the regular thoracic surgical section or furnish qualified personnel if no qualified thoracic surgeon is on the regular staff. It is highly desirable to have a thoracic surgical team functioning in an evacuation hospital and devoting their attention to the treatment of patients with major thoracic injuries.

In quiet periods at the front when there is no need for beds for imminent battle casualties, certain surgical procedures such as the removal of intra-pulmonary foreign bodies and pulmonary decortication for organizing hemothorax are undertaken.

In fixed installations, station or general hospitals in the base section area, the thoracic surgeons have a real opportunity. Every effort is made to return the patients to duty within 90 days. This policy has led to several noteworthy contributions: the removal of intrapulmonary foreign bodies within 10 days to 3 weeks after injury; the radical management of massive organizing hemothorax by thoracotomy; evacuation of the clot and decortication of the lung. The same procedure applied to established post-traumatic empyema with penicillin therapy as an adjunct has led to immediate healing with a fully expanded lung. This has been one of the significant advances in the surgery of World War II. To the thoracic surgical teams of an auxiliary surgical group goes much of the credit for these advances.

The use of thoracic surgical teams in fixed installations often has permitted the completion of the reparative phase of surgery by the same surgeons that have dealt with the initial phases of wound management in the forward hospitals.

The organization of a large number of highly trained surgeons into surgical teams under one central control was new and untried several years ago. Few hospitals considered the need for the assistance furnished by such teams. However, today the usefulness of such an organization is fully recognized and appreciated by all who have first hand experience in the problems confronting the medical science of an active theatre of operations.

RONALD R. BRADLOW, M.D.

SURGERY OF THE ABDOMEN

ABDOMINAL WALL AND PERITONEUM

Brandon, W J M: Inguinal Hernia; The New Muscular Internal Ring *Lancet* Lond. 945 249 8 2

The author points out that the only common factor in the various types of hernia repair is the retention of the original muscular internal ring. Closure of this ring when the cord and testicle are removed has proved uniformly successful. The conclusion is drawn that the internal ring is the potential source

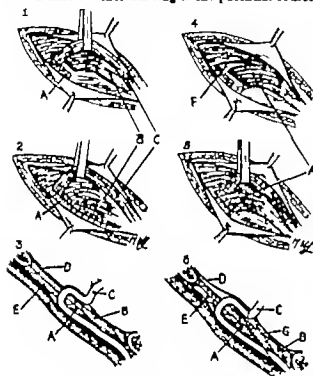


Fig. 1. A, Incision of internal oblique and transversalis muscles. B, conjoined tendon. C, spermatic cord.

Fig. 2. A, Incised muscles reconstituted to form new muscular internal ring. B, entire inguinal canal closed by suture of conjoined tendon to Poupart ligament.

Fig. 3. A, Portions of internal oblique and transversalis muscles sutured medial to cord. B, sutured conjoined tendon. D, transversalis fascia. E, lateral portion of internal oblique and transversalis muscles.

Fig. 4. A, Internal oblique and transversalis muscles incised. F, muscles separated in the line of their fibers. (Spermatic cord omitted.)

Fig. 5. New muscular internal ring full constructed.

Fig. 6. A, B (sutured conjoined tendon) Anterior blade of shutter giving full protection to true internal ring. C, spermatic cord emerging from new muscular internal ring after taking an S-shaped bend. D, transversalis fascia forming posterior blade of shutter and protecting new muscular internal ring. E, internal oblique and transversalis muscles. G, dotted lines showing path taken by spermatic cord in all well-known posterior repair operations.

of weakness and that all recurrent hernias may be shown to involve the internal ring.

A modification of the Bassini repair is described, in which the essential feature is the construction of a new muscular ring. The internal oblique and transversalis abdominal muscles are incised so as to form a "V" at the old internal ring. This muscle is then sutured about the cord to form a new ring, as shown in Figs. 1, 2 and 3. A slightly different technique in which the fibers of the muscles are split at the apex of the "V" to further move the internal ring from its original position, is shown in Figs. 4, 5 and 6. In this way the obliquity of the emergence of the spermatic cord from the abdomen is changed and made more angular. There is then a two bladed "shutter" over the internal ring—one the transversalis fascia, another formed by the new muscular ring, and both permanently closed and not in opposition to one another.

The author concludes that for the moment this new suggestion in the repair of inguinal hernia is a thesis and that proof of its efficacy must await the test of time.

THOMAS C. DOUGLAS, M.D.

GASTROINTESTINAL TRACT

Candino, A. The Arterial Circulation of the Stomach. Gastric Hemorrhage (*Circulación arterial del estómago. Hemorragia gástrica*) *Rev Gastroenterol* 945 10 91

The author removed the stomach and the adjoining part of the duodenum from cadavers, preserving all the arteries. Specimens were obtained from fresh cadavers to avoid maceration of the tissues. The main arteries were injected with a radiopaque substance and roentgenograms were taken. In this manner the author studied the distribution of the blood vessels in normal stomachs and in those with peptic ulcers.

He came to the conclusion that there is a perfect equilibrium between the arterial pressures of the main arteries. Various factors collaborate in the regulation of the pressure, velocity, and quantity of the blood passing each branch. One could expect that a peristaltic contraction might produce an anemic zone because of the compression of the blood vessels, but in reality this is not the case. The direction of the main arteries is identical with that of the peristaltic waves, which facilitates the blood flow. Numerous anastomoses also contribute to the maintenance of a continuous blood current.

The diagnosis of the origin and mechanism of a grave gastroduodenal hemorrhage is of paramount importance in the selection of proper treatment, namely the choice between a pure expectant treatment, active medical therapy and surgical intervention. The gravity of anemia must be determined by a study of the blood pressure, pulse, blood count, and

the amount of hemoglobin. The determinations of pulse and arterial pressure are of limited value because shock may produce a similar picture. Therefore the blood count and determination of the amount of hemoglobin are of greater value. A grave hemorrhage in the stage of evolution produces a pulse of gradually increasing frequency and an arterial pressure which gradually falls. On the other hand shock is followed by a fall of the blood pressure which remains stationary for a time, but gradually returns to normal levels in favorable cases.

A grave hemorrhage causes a progressive diminution of the number of red blood corpuscles. As a rule, an acute hemorrhage responsible for a fall of the number of erythrocytes to 3 000 000 within the first 3 hours gives a very grave prognosis. A red blood count of as little as 1 to 2 million is compatible with life, while in chronic anemias the organism may survive a count even lower than 1 000 000 erythrocytes.

An amount of hemoglobin lower than 30 percent is not compatible with life and therefore a fall of hemoglobin in between 40 and 50 per cent requires a blood transfusion.

A pulse frequency between 130 and 150 gives a serious prognosis and a systolic pressure between 80 and 90 is also alarming.

While laboratory examinations furnish information as to the gravity of symptoms, clinical examination should attempt to establish the cause of hemorrhages. It must be remembered that various conditions may be responsible for a gastroduodenal hemorrhage, e.g. ulcers, hemophilia, gastric varicosities, venous hypertension caused by a cirrhosis of the liver, blood dyscrasias caused by cholelithiasis, primary or secondary gastric hemorrhage produced by Banti's disease, syphilis of the stomach, cancer and congestion within the stomach wall caused by retention due to pyloric stenosis.

Hemorrhages from capillaries or precapillaries are benign, as a rule, while those from larger blood vessels require a surgical hemostasis.

If conservative treatment is decided upon, an icebag should be placed in the dorsolumbar region, and not over the epigastrium because the vasoconstricting reflex of neurogenic origin can be stimulated easier in this manner. Liquids should be given hypodermically in preference to their intravenous administration in order to avoid an overloading of the circulatory system. The amount given depends on the quantity of lost blood, the condition of the pulse, and the blood pressure. The amount of blood to be transfused also should be related to the amount of blood lost.

In chronic anemia a relatively small amount of transfused blood may raise the blood pressure, but this is not the case in patients with an acute hemorrhage who tolerate large amounts of blood without a rise in their blood pressure. A few days may elapse before the blood pressure returns to normal limits after a transfusion of relatively large amounts of blood. A patient with 3 000 000 erythrocytes a

hemoglobin of 60 per cent, and a systolic pressure of 100 requires larger amounts than 400 c.c. of blood.

Vitamin K should be administered intravenously in sufficient amounts. The oral administration of bismuth is to be condemned because the drug has no local hemostatic effect and may provoke vomiting.

No food whatsoever should be given during the acute hemorrhage, but after the bleeding has stopped spontaneously or under the influence of treatment, liquids and later on the white of an egg, gelatin and chopped meat may be offered.

An internist should treat the patient with acute gastric hemorrhage until the etiology of the condition has been established. The cause of hemorrhage is the determining factor in the choice of definite treatment.

The roentgenological studies of the gastric arteries convinced the author that an efficient hemostasis requires extirpation of the source of the hemorrhage.

JOSSEPH K. VAKAT, M.D.

Dragstedt, L. R.: Vagotomy for Gastroduodenal Ulcer. *Ann. Surg.* 1945 122 973.

In this communication the author reports the present status of section of both vagus nerves in the treatment of peptic ulcer. The operation was undertaken because of the conjecture arrived at by experimental work on the lower animals that pure gastric juice as secreted by the fundus of the stomach has the capacity to destroy and digest various living tissues including the wall of the jejunum, duodenum and even the stomach itself. The chief secretory abnormality in ulcer patients lies not in the production of a juice with higher than normal acidity, nor even in the production of more normal juice in response to the usual stimuli, although there is some evidence that this occurs, but rather in the secretion of abnormally large amounts of gastric juice in the intervals between meals, particularly at night when the stomach is empty and there is no obvious stimulant.

Through animal experimentation it was found that section of the vagus nerves to the stomach reduced the secretion of gastric juice in dogs to one half or even one fourth of the normal level. The data obtained so far suggest that the hypersecretion of gastric juice in ulcer patients is neurogenic in origin and that, consequently, a comparatively greater reduction should follow vagus section in man than in lower animals.

In all the author and his associates have operated upon 39 patients with peptic ulcer by sectioning the vagus nerves. The transthoracic approach by resection of the seventh or eighth rib is preferred to the abdominal approach although the latter has been used in 7 cases.

Postoperatively, the author employed the insulin test to determine if all the vagus secretory fibers to the stomach were interrupted. The rationale of the test lies in the fact that hypoglycemia induced by an adequate dose of insulin stimulates the vagus secretory fibers to the stomach, probably by an effect on

the central nervous system. No effect whatever occurs if the vagus section has been complete.

Of the 39 patients subjected to the operation at the time of this report, 1 died. This patient developed postoperative bronchopneumonia. Thirty of the patients in this series had duodenal ulcers; 3 had gastric ulcers and 7 had gastrojejunal ulcers. Eight of those with duodenal ulcer were subjected to gastroenterostomy in addition to the vagus section because of high grade pyloric stenosis. In most of the cases of this type the vagus section was done by the abdominal approach at the same time as the gastroenterostomy. Only 1 of the patients with duodenal ulcer failed to obtain striking and persistent relief from his symptoms and in this case there were many features suggesting a neurosis. The first group of patients have been followed up for 2½ years and, so far, have remained well on unrestricted diets and without medication. For the remainder of the patients a longer period of observation is required before conclusions can be drawn, especially in the cases of gastrojejunal ulcer.

The operation has no effect on the secretory response of the stomach to histamine or caffeine but abolishes the stimulating effect of insulin hypoglycemia and a sham meal. Vagotomy reduced gastric secretion in the empty stomach at night from 50 to 60 per cent. It also resulted in the reduction of hypertonicity but the tone and motility of the stomach were not abolished. An interesting observation was the fact that patients who complained of constipation before the operation were relieved of this disturbance. Further study of this effect is necessary.

HAROLD LAUFMAN, M.D.

Riera, M., and Diaz, F. Low or Infrabulbar Duodenal Stenosis (*Estenosis duodenales bajas infrabulbares*). *Rev. med. Chile*, 945 73 855

In the majority of cases of duodenal stenosis the narrowing is located in the bulb and caused by a peptic ulcer. Roentgenograms show a pyloric stenosis with a secondary dilatation of the stomach. Stenosis in the lower segments of the duodenum is rare and may be due to various factors. As a rule, roentgenological studies allow a correct diagnosis and often throw light on the nature of the lesion.

An infrabulbar duodenal stenosis may be congenital or acquired and of intrinsic or extrinsic origin. A congenital stenosis is usually caused by a malformation. Complete duodenal atresia is incompatible with life. A ring of atrophic pancreatic tissue may cause a compression of the duodenum. In such cases a concentric stenosis of the second portion of the duodenum with smooth borders is seen in the roentgenograms. A diverticulum may produce a duodenal stenosis, especially when it is filled with food. In this respect the condition may be compared with stenosis of the esophagus caused by a distended Zenker's diverticulum.

A spastic condition must be taken into consideration in an acquired duodenal stenosis. Such spasm may be caused by a stone impacted in the common

duct. Roentgenograms are essential for the diagnosis in such cases. Tumors of the duodenal wall or an extrabulbar peptic ulcer may produce a stenosis of the duodenum. A cancer of the duodenum responsible for a stenosis has been reported. In the majority of cases an infrabulbar stenosis is due to an extrinsic lesion. The second portion of the duodenum may be compressed by the middle colic artery if ptosis of the right portion of the colon changes the normal position of the blood vessel. The root of the mesentery may compress the duodenum in patients with an intestinal ptosis or a short mesentery. In such cases the duodenum is compressed between the spinal column and the mesentery. There is also an acute type of arteriohepatic stenosis the mechanism of which is still under discussion.

An extrinsic infrabulbar stenosis may be caused by a tumor in one of the adjoining organs, either by compression or infiltration of the duodenal wall. Tumors of the gall bladder, pancreas, liver or the left kidney may cause a compression of the duodenum. Acute hemorrhagic pancreatitis may be followed by an enormous increase in the volume of the organ, with compression of the duodenum.

Mesenteric lymph glands enlarged on account of Hodgkin's disease, leukemia, or lymphosarcoma may produce infrabulbar compression of the duodenum. An aneurysm of the aorta may also be responsible for such a compression. Periduodenal adhesions, pericholecystitis, plastic postoperative peritonitis, or congenital bands may cause a compression of the infrabulbar portion of the duodenum.

Roentgenographic studies reveal a dilatation of the duodenum above the stenosis and an abnormally long retention of the ingested barium. A vigorous palpation of the involved region may provoke antiperistaltic waves and in the presence of pyloric insufficiency a reflux into the stomach may be observed. An obliteration of the mucosal folds is typical for the distention above the stenosis. If the stenosis is not complete, irregular contours of the duodenum may be noticed in the roentgenograms. Introduction of an opaque substance through a duodenal sound may prove useful. Peristaltic movements of the normal duodenum may be confusing and therefore repeated examinations are desirable. A supernumerary duodenal loop in the second portion of the duodenum may also create confusing images.

The authors report 11 cases of infrabulbar duodenal stenosis, 5 in men and 6 in women. In 9 it was possible to establish a definite etiology while in 2 the cause remained doubtful. The ages of the male patients ranged from 22 to 42 years and of the female from 40 to 78 years. JOSEPH K. NARAT, M.D.

Hoot, A., Five Cases of Cholecystoduodenostomy (*A propos de Cinq cas de cholecystoduodenostomie*). *Union med. Canada*, 946, 75 24.

As a rule, cholecystogastrostomy is preferred to cholecystoduodenostomy although it is a less physiological method. If technical difficulties are encountered,

tered occasionally a cholecystojejunostomy is performed although it is the least satisfactory method.

In the course of 10 years the author performed 5 cholecystoduodenostomies and only 2 cholecystogastrostomies. Usually these operations are done on account of bile fistulas with great loss of bile or on account of retention icterus. The last mentioned indication was present in 4 patients in the author's material. All of them had a cancer with numerous metastases in close vicinity to the primary tumor and at distant places. In 2 patients jaundice was due to carcinoma of Vater's papilla in 1 patient it was due to a cancer of the pancreas and in a fourth it was due to a malignant tumor of the common duct.

In 4 cases the anastomosis was employed as a palliative measure to limit bile drainage to suppress jaundice and to create in the patients the impression that they were cured. The patients survived the operation 14 months, 3 months, and 1½ months, respectively while the fourth patient succumbed to a bronchopneumonia on the eighth postoperative day.

As a rule patients undergoing cholecystoduodenostomy are undernourished and icteric and suffer from pruritus which interferes with their sleep. Small and frequent meals of easily digestible food are prescribed. The preparation of the patient for the operation should not exceed from 8 to 20 days and therefore oral feedings are supplemented by the subcutaneous administration of 5 per cent glucose solution 500 c.c. in 24 hours, with the addition of from 10 to 30 units of insulin. The fact should be remembered that such individuals easily develop a hypoglycemic crisis.

In view of the fact that the majority of patients requiring this type of an operation are cachectic and have hypotension a daily injection of from 4 to 6 c.c. of adrenal cortex extract divided in two doses, is given. The author avoids ephedrine on account of the resulting insomnia. However in the course of the operation an injection of 2 c.c. of ephedrine with 5 c.c. of adrenal cortex extract is given. From 6 to 10 c.c. of this extract are administered daily for the first 3 days following the operation and lesser amounts are given thereafter until the patient is able to get out of bed.

A hypnotic is given to provide sleep. As a rule the hypnotic is combined with 10 drops of a mixture of equal amounts of tincture of belladonna and tincture of stramonium to intensify the action of the barbiturates.

To diminish the hemorrhagic tendency of icteric patients, from 10 to 20 c.c. of a 10 per cent calcium chloride solution are given intravenously every day for 4 days preceding the operation.

No food is given by mouth the first 48 hours following the operation and during that time 1000 c.c. of normal saline solution, from 30 to 40 c.c. of a 10 per cent saline solution, and from 1000 to 1500 c.c. of glucose solution with 20 to 40 units of insulin are given when necessary.

Except in 1 case, the author employed local anesthesia combined with a basal anesthetic. The

anesthetic given per rectum consisted of chloral (4 gm.) potassium bromide (4 gm.) 1 yolk of an egg and milk q.s. ad. 300 c.c. for local anesthesia. The author used from 60 to 80 c.c. of a 1 per cent solution of novocaine without the addition of adrenalin because the latter produces a temporary hemostasis followed toward the end of the intervention by a reflex vasodilatation and oozing. After the peritoneal cavity has been opened a mesocystoduodenocolic anastomosis is obtained with a 0.5 per cent novocaine solution.

After the bile has been aspirated from the gall bladder the organ is united with the second portion of the duodenum. Sometimes it is necessary to separate the gall bladder from the lower aspect of the liver. Catgut No. 00 is used for the anastomosis. The rent is about 2 cm. long. The incision in the duodenum is made in the vertical direction. The second row of sutures is made with linen or chromic catgut No. 00. Sometimes omentum is attached to the suture line. Two drains are inserted one into the subhepatic region and the other at the site of the anastomosis. The drains are left in place from 24 to 48 hours.

JOSEPH K. NARAT, M.D.

Spatalisano B.; Atypical Initial Reticuloendothelioma of the Jejunum Associated with Chronic Stenosing Jejunitis (Reticuloendothelioma atipico iniziale del digiuno associato a digitulite cronica stenoiante). *Gior. Ital. Chir.* 1945, 1, 35.

The author describes the combination of a chronic, nonspecific inflammatory process with a tumor formation of reticuloendotheliomatous character in a 45 year old woman who was admitted with complaints of pain in the epigastrium of 1 year's duration. She vomited on rare occasions. Diarrhea alternated with constipation. A considerable degree of malnutrition was present. Roentgenographic studies disclosed duodenopyloric stenosis.

An operation was performed under a combined basal and local anesthesia. A deformity of jejunum 7 cm. long was found 3 cm. from Treitz ligament. In the involved region the intestinal wall was thickened and indurated and the corresponding mesentery was infiltrated and contained numerous small lymph nodes. There was a sharp line of demarcation between the affected portion and the adjoining healthy tissue. The lesion was resected and an end-to-end anastomosis was performed. The patient recovered.

Reticuloendothelioma is characterized by (1) a mesenchymal aspect and the capacity of producing reticular fibrillae (2) phagocytic activity (3) syncytial structure, and (4) the tendency to develop chiefly in endothelial direction. The following varieties may be distinguished (1) tumors with a mesenchymal aspect, (2) tumors with a reticular aspect (3) tumors with a pulposplenic aspect (4) giant cell tumors, and (5) tumors with an endothelial aspect.

The inflammatory process in the author's case resembled regional ileitis. The author believes that

the tumor developed following the inflammatory process.

JOSEPH K. VARAT, M.D.

Tan, C. C., and Liu, Y.: Amebic Colitis with Special Reference to Perforation. A Study of 20 Autopsied Cases. *Chin M J* 1945 6 366.

During a period of 19 years the clinical diagnosis of amebic colitis was made in 349 patients in the hospital of the Peking Union Medical College. In 9 of 20 cases in which autopsy was performed, perforations were found. Eleven of 20 patients gave no history of dysentery of those with perforation all except 1 were admitted with symptoms and signs of acute amebic dysentery which had been present from 1 week to 4 months. Of the entire series of cases more than half showed varying degrees of diffuse ulceration usually in the sigmoid colon and the cecum. The cecum presented the most severe lesions and the largest number of perforations. The ileum was involved in 7 of 20 and the appendix in 5 of 15 cases examined. The cecum was perforated in 5 instances, the descending colon in 4, the sigmoid in 2 and the transverse colon in 1 instance. In 3 instances multiple perforations were found.

The authors point out that whereas the diagnosis of amebic colitis is usually simple that of perforation may be easily missed particularly if there is no history or previous diagnosis of amebic colitis. Abdominal distention, tenderness, and muscle spasm are the common early findings. Emetine is not effective in controlling perforation after the anatomical lesions reach an advanced stage. Once perforation of the intestine occurs, the chance of recovery is slight. One case in which the patient survived perforation of the cecum and the formation of a fecal fistula is reported.

WALTER H. NADLER, M.D.

Pfeiffer D. B., and Patterson F. M. S.: Congenital or Hereditary Polyps of the Colon. *I. A. Surg* 1945 2 606.

In every individual who is found to have rectal polyps a complete study of the intestinal tract is necessary. This includes proctoscopic examinations, barium enema studies (postevacuation films and double contrast studies), and, finally roentgenograms of the stomach and small intestine.

The family history of every individual with multiple polyps of the colon should be thoroughly investigated since this condition is often on an hereditary basis. Early diagnosis and treatment is very important for intestinal polyps tend to become malignant.

A satisfactory plan of treatment includes fulguration of the polyps in the anus, rectum and sigmoid followed later by ileorectosigmoidostomy and finally, by colectomy. The outlook for these patients is good if treatment is begun early.

Five cases of multiple polyps of the colon are reported 4 of which had a definitely hereditary aspect. The classification, etiology, pathology, symptoms, diagnosis and treatment of congenital

multiple polyps are discussed and special emphasis is placed on the tendency of the polyps to undergo malignant changes.

JOHN L. KIRKPATRICK, M.D.

Weinberger H. A.: Observations on Large Bowel Perforations. *Surgery* 1945 18 547.

In the Lenox Hill Hospital, New York, 19 cases of large bowel perforation were recorded among 1,400 autopsies during the last 10 years. Ten of the 19 cases were attributable to a perforation complicating diverticulitis, 7 were due to malignancy and 2 were due to perforation by mechanical agents within the lumen. Four recent cases in which autopsies revealed perforations of the large bowel are reported in detail.

Attention is called to the high morbidity and high mortality in diverticulitis complicated by perforation. The prognosis is also grave in large bowel malignancies that are complicated by perforation, which may cause the first serious symptoms in from 10 to 20 per cent of these cases.

Two unusual cases of perforation of the sigmoid due to an intraluminal insult are recorded, one was due to impaction of a fowl bone and the other was caused by rupture after a vigorously administered enema.

Treatment of perforation from any cause is essentially the same. The surgical measures stressed are early and generous drainage with a minimum of manipulation of the site of penetration and a proximal decompressive colostomy.

WALTER H. NADLER, M.D.

Meyer K. A., and Kozoll D. D.: Preparation for Surgery of Patients with Colon Lesions. *J. Coll. Surg.* 1945 9 249.

By virtue of a carefully planned preoperative operative and postoperative regimen, it has been possible to resect the colon if unobstructed, perform a primary "open" anastomosis, return the colon to the peritoneum without performing a proximal colostomy and close the wound without drainage with only one death among the first 26 patients with lesions of the left half of the colon who were treated in this manner. This was possible only because of the many physiological aids with which the authors were able to surround their surgical patients. The advantages of this procedure over previous ones in which a colostomy (either proximal to or at the site of resection) was required are: (1) a more radical resection is possible because no bowel has to be spared for use as a proximal or distal loop of the colostomy; (2) such complications of exteriorization operations as wound infection, herniation, prolapse, fecal fistula, obstruction, and stricture formation are obviated; (3) a temporary colostomy and the morbidity associated with its closure is avoided and (4) primary resection and anastomosis without proximal colostomy is a one stage operation with a shortened period of hospitalization and no return visits for subsequent operations.

The authors describe their preoperative management with special reference to diet parenteral amino acids plasma infusions blood transfusions succinylsulfathiazole vitamins enemas Levine tube suction complicating diseases and preanesthetic medication.

The importance of an adequate diet in patients with malignant lesions of the colon is best illustrated by the incidence of hypoproteinemia in this disease the authors have reported an incidence of 30 per cent, compared to the average incidence of 23 per cent in a large group of surgical lesions.

The value of amino acid digests for parenteral protein nutrition in human beings both to supplement that which can be given by mouth and to supplant oral feedings when the latter is unfeasible has been demonstrated. The availability of amino acids for intravenous use is an important adjunct to surgery and can often be lifesaving.

The use of plasma as a source of protein nutrition has long been recommended but subsequent experiences have indicated that it too has shortcomings.

If one remembers the constituents of blood one should not be surprised that whole citrated blood transfusions have proved the most important aid in the preparation of patients for operation. The authors believe there is a striking effect produced by whole blood with amino acids and they combine these two fluids in clinical practice on the theory that amino acids will be utilized for tissue protein metabolism whereas the whole blood will be more effective upon the circulating proteins.

Succinylsulfathiazole has been the single greatest boon to colon surgery and has given considerable confidence in the undertaking of primary colon resections by an open technique rather than to rely upon crushing clamps with which so-called aseptic anastomoses are carried out. With the advent of this plan of chemotherapy not a single instance of postoperative peritonitis has been seen in the authors' series of cases and only 1 patient developed a wound infection which required drainage.

The indications for vitamin therapy in the preparation of surgical patients are manifold. Most of these patients have a deficiency of one or more vitamins.

The first enema and cathartic are given prior to the start of succinylsulfathiazole therapy. The second enema is given during the 24 hour period preceding surgery; this is done to allow the drug to attain as high a concentration as possible.

Intragastric suction should be established before operation to prevent distention. Control of distention prevents tension on the suture line and is as effective as a proximal colostomy with regard to decompression. Also the intragastric tube will aspirate swallowed inhaled anesthetic gases if used and help prevent postoperative aspiration pneumonia. Still another value in the use of this tube lies in the fact that the patient can drink freely immediately after operation which minimizes the dangers of a postoperative parotitis.

Because most patients with colonic diseases are in the sixth and seventh decades, a proportionately higher incidence of diabetes hypertrophied prostatic disease hypertension and oral sepsis is present. Unless the patient is acutely obstructed all of these conditions demand correction before bowel resection is undertaken.

The authors describe their operative management with special reference to anesthesia open versus closed resections, sutures, wound repair blood transfusions Levine tube suction and vasoconstrictive drugs.

Whenever possible they have employed nupercaine spinal anesthesia which provided an adequate period of anesthesia without the use of inlying intraspinal needles.

Any attempt at following a so-called aseptic technique in anastomosis has been avoided deliberately, for it is believed that the use of clamps in closed resection is not without the danger of necrosis of the bowel edges and is cumbersome.

The authors employed the principle of fine interrupted sutures on atraumatic needles in the anastomosis and the wound as well.

Interrupted sutures are used in closing all layers of the wound.

Blood transfusions are given during the operation although the patient may have received 2000 c.c. or more of blood during the preoperative period. This is the most effective means of preventing shock and compensating the patient for blood loss sustained as the result of surgery.

Suction with the Levine tube is continued during the operative period to decompress the stomach which might otherwise obscure the operative field to prevent the swallowing of inhaled gases if given, and to prevent the aspiration of gastric content through emesis.

Vasoconstrictive drugs are given to prevent the drop in blood pressure frequently seen with spinal anesthesia the authors' particular preference is neosynephrin.

Granted that the patient is operated upon most skillfully after having been prepared as carefully as outlined a successful result will not be achieved unless he is given equally painstaking postoperative care. This care includes a wide variety of therapeutic adjuncts, many of which have been outlined in the preoperative regimen.

Attention must be paid to the physiological principles of fluid balance.

Blood transfusions were rarely necessary postoperatively in patients who have been given 2000 c.c. or more of blood before and during operation. However unlimited quantities of whole blood are administered to patients showing the need for it.

The rationale for the authors' use of parenteral amino acids has been discussed but the need for them is frequently more acute because of starvation which may follow colon surgery.

The rationale for gastric suction has been outlined. Suction should commence before the patient is sent

to the operating room continued during the operation and resumed immediately after his return to bed

Hyperventilation is employed routinely with mixtures of carbon dioxide and oxygen, and is administered every 1 or 2 hours until the patient breathes deeply or coughs. By this means greater oxygenation of the pulmonary alveoli occurs, mucus is dislodged and pulmonary complications are avoided. Oxygen is used routinely either with a nasal catheter or nasal mask in patients whose condition is precarious or who have a cardiac complication.

Vitamins are administered with the intravenous fluids in the dosages given during the preoperative period they are given orally when the patient resumes a diet, but are usually not necessary when he is ready to leave the hospital.

While the patient is on gastric suction, all sulfonamides are administered intravenously in dosages adequate to maintain a level of from 8 to 12 mgm. per cent in the blood. Sodium sulfadiazine is the drug of choice and usually not more than 5 gm. per day is required.

The drinking of water is encouraged as soon as the patient returns to bed.

Elevation of the foot of the bed is employed for the first 24 hours to prevent shock and encourage the drainage of mucus from the respiratory tract.

Catheterization is required more frequently after spinal anesthesia and is done if the patient has not voided by the end of the first day.

Patients are placed in a wheel chair for 15 minutes on the first postoperative day and more frequently and for longer intervals thereafter. They walk without aid by the sixth or seventh day.

The diet is not resumed until the Levine suction tube has been withdrawn.

Enemas are not administered until the fifth or sixth postoperative day and then only in small amounts.

CHARLES BARON, M.D.
Mason J. W., III: Surgery of the Colon in the Forward Battle Area. *Surgery* 94:5 8 534

About one-half of the diameter of the entire right colon both flexures and a portion of the rectosigmoid is found to lie behind the peritoneum. In explorations and for the relief of tension on colostomies, the simple procedure of mobilizing these areas should be kept in mind. The lateral attachments of these portions of the colon are avascular, the mesentery coming in from the medial aspect, and they can be incised with impunity the colon being displaced medially.

Injuries of the right colon from the ileocecal junction distally which necessitate the removal of the cecum and any portion of the right colon are a problem because of the difficulty in dealing with the transected end of the terminal ileum. The open end of the ileum is, of course, a problem because of the erosive action of its contents, if they are allowed to drain out into the abdominal wall. There are four ways of handling this problem

1 A primary anastomosis may be performed between the terminal ileum and the cut end of the transverse colon (end to side ileotransverse colostomy) the blind end of the colon being turned in by suture.

2 An end to side primary anastomosis may be performed, the blind open end of the colon being brought out of the abdomen through a stab wound as a safety valve.

3 A lateral anastomosis may be performed between the ileum and the colon, both ends (ileum and colon) being brought out distal to the anastomosis as a double barreled spur colostomy.

4 The ileum and colon may be exteriorized as a long sutured double barreled ileocolostomy constructed for the purpose of early crushing of the spur with a clamp.

The first three procedures are objectionable since they necessitate a primary anastomosis in an unprepared colon. This is too dangerous. The fourth alternative is the one which has been used with good results. Early crushing of the spur at the base of the hospital within two or three weeks or earlier crushing at the front preferably the former will prevent any irreparable skin erosion. Postoperative care consisting of the administration of vitamins the correction of dietary deficiencies and the restoration of the blood chemistry to normal levels will play a large part in such treatment.

All exteriorizations should be made through separate stab wounds and not through the upper or lower poles of an exploratory incision. Often it has been convenient to bring a colostomy out through a debrided wound of entrance or exit, but this is avoided if possible. There is a place for tube colostomies in the management of single perforations of the cecum. However in general, it is preferable to exteriorize such wounds. The evacuation of the patient and the change of management that he is subjected to may result in periods of time during which the proper attention cannot be paid to the tube.

A tube may be of advantage in diverting the stream of fecal contents in an ileocolostomy or it may be used in a colostomy but its period of usefulness is not very long as leakage soon occurs around the tube.

Questionably viable areas of colon due to a damaged mesentery or to trauma to the wall of the gut proper should be exteriorized.

The management of war wounds of the colon differs materially from the management of lesions of the colon generally encountered in civilian practice. The excellent results obtained in civilian practice by the performance of primary anastomosis on the properly prepared colon permits the immediate re-placement of the anastomosed portion in the general peritoneal cavity. In dealing with emergency war surgery it is believed that all colon injuries should be exteriorized and that no primary anastomosis is warranted.

BENJAMIN GOLDMAN, M.D.

Pierpont R. Z. Peterson F. R. and Dullin J. W.: *Operative Results of Surgery of the Colon for Neoplastic Disease* *Surgery* 1945 18 541

The operative results of colon surgery for neoplastic disease covering the period between January 1 1937 and December 31 1944 in the State University of Iowa Hospitals Iowa City are reviewed and the results of treatment tabulated. Exploration was carried out in 221 patients and of these 117 had resection of the colon a resectability rate of 53 per cent.

Among the 221 patients operated upon there were 46 deaths a mortality of 20.5 per cent. Among 117 resections 23 deaths occurred a mortality rate of 19.6 per cent. Among 81 patients in whom a palliative operation was done for the relief of obstruction there were 17 deaths a mortality rate of 20.9 per cent. Altogether there were encountered 122 lesions of the left side and 82 lesions of the right side.

The authors report that an increasing number of resections with immediate end to end anastomosis are being performed in their clinic and point out that there is no one operative procedure which can be applied to all neoplasms of the colon.

WALTER H. ADLER M.D.

Miles, W. E., Gordon Watson C., Milligan E. T. C. and Corbett R. S.: A Discussion on the Management of the Permanent Colostomy. *Proc. A Soc. M. Lond.* 1945 35 695

Miles observed that very few doctors appreciate the value of the daily wash-out of the colon for controlling bowel movements. There is no doubt what ever that bowel action can definitely be controlled by means of a daily wash-out with 1½ pints of plain water at a temperature not exceeding 80 F. as determined by the thermometer. This is repeated if necessary. Should the temperature exceed 80 F. inertia of the muscular coat of the colon is produced which results in retention of part of the fluid used and several hours may elapse before the muscular inertia disappears. A plain wash out if properly administered can be relied upon to clear the colon completely of its fecal contents. It sometimes happens that difficulty is experienced in introducing the tube into the colon to the required extent. As a rule this is due to the attempt to introduce the tube when the patient is sitting up or standing, or when he raises his head in order to pass the tube under guidance of the eyes and puts his abdominal muscles on the stretch. In order to pass the tube the patient should be recumbent with the abdominal muscles completely relaxed. One of the causes of difficulty in passing the tube is acute angulation of the colon at the point where it changes direction and passes forward to the opening in the anterior abdominal wall. Such angulation can be entirely prevented by mobilization of the terminal portion of the descending colon.

A weak spot in the abdominal wall has been created by the passage through it of the loop of pelvic colon destined for the formation of the colos-

tomy. In order to afford support to the weakened abdominal wall a well fitting colostomy belt must be obtained. On no account should the patient allow himself to be persuaded to have a rubber bag attached to the cup of the belt to act as a receptacle for feces. Such a bag creates suction and in the course of time the part of the colon which is proximal to the stoma is turned inside out and extruded through the stoma. It is important that the belt should be worn continuously when the patient is up and about.

The stoma of a colostomy should be prevented from becoming stenosed by systematic dilatation. For this purpose the patient must be taught to pass his index finger to its full extent through the stoma. He must also be instructed how to pass his finger to its full extent before flexing the distal joint. As soon as the colostomy wound has healed firmly the index finger of the left hand (if the stoma is on the left side) should be passed through the stoma every day for a month then once a fortnight for two months and finally once a month for six months, when it will be found that the tendency to contract has ceased.

GORDON WATSON states that in order to secure a good working colostomy it must be well fashioned and first of all it is essential to secure a good spur by keeping the bowel outside of the abdominal wall for at least three weeks by the use of a glass rod or other means it is also necessary to avoid undue tension on the mesentery. The stoma should be well clear of the anterior superior iliac to avoid interference with the belt. The size of the opening in the abdominal wall should be just large enough to allow a finger to pass down on either side of the glass rod. An ellipse of skin should be removed to prevent subsequent contraction which is apt to cause recession of the opening. All cups and bags should be avoided a plain celluloid disc is all that is needed. Some patients find this unnecessary and wear only a singlet.

The colostomy is trained to act only when it is washed out, which is done at the same time each day with plain tepid water without soap and a flexible tube (size 14) which is passed up as far as possible with great care. The fluid is run in slowly preferably by funnel.

When this is carefully carried out at the same time each day the colon learns to respond in an automatic way and many victims carry on their work with little disability. In a small percentage of cases the colon will behave as if the stoma was the rectum and act regularly and automatically without a wash-out with or without a mild aperient. If there is a tendency to looseness disastera may occur.

GABRIEL stated that after a colostomy (terminal loop, left iliac, or transverse) has been established, we have to decide if the bowel is to be allowed to act naturally or whether the wash-out regime is to be adopted. He is opposed to the wash-out regime for colostomies for the following reasons:

1. It is unnecessary because the great majority of colostomy patients have good intestinal function.

and with reasonable care and discretion in diet they achieve a satisfactory and regular rhythm with formed colostomy actions.

3 It is harmful because it is not natural for the colon to have a solution thrust into it daily be it plain water, normal saline solution or soap and water. Colonic lavage for prolonged periods induces a chronic catarrh of the colon with a hyperemic mucosa, a contracted bowel lumen, and the excessive formation of mucus. In other words this routine induces a state of catarrh and irritability in the colon which is exactly contrary to what is desirable after a colostomy.

3 It is dangerous because the passage of a tube up the colostomy may lead to perforation, peritonitis, and death. In hospital work a colostomy wash-out is rarely necessary in the immediate postoperative period and usually the insertion of a glycerine suppository serves the purpose equally well.

MILLIGAN says that there is no surgical substitute for the rectum. The rectum is under the control of the patient for storage and ejection. A colostomy can never be trained to have conscious sensations or voluntary powers similar to the rectum. The crude muscles of the abdominal wall cannot act like the specialized rectal and anal muscles in retention and expulsion.

The same rhythm or regularity of bowel action can be attained with a colostomy as with a normal rectum that is, the 24 hour rhythm for in all of us with or without a rectum this rhythm depends upon the colon.

This author states, "We cannot control the colostomy but it can be controlled." He also maintains that Nature's standard of one and only one motion a day can be reached with a colostomy. How then are we to attain but one bowel action a day for a colostomy?

The answer is by routine morning wash-out if the rhythm does not come naturally after a short trial. A bowel completely emptied by a wash-out followed by a morning bath and clean dressings enables a man to face the day and his fellows without handicap.

The bowel action is likely to be regular after the removal of the rectum if the daily evacuation before colostomy was by rhythm rather than by feeling.

CORBETT considers the subject under two headings: (1) the part played by the patient and (2) the part played by the surgeon.

The patient wants a regular evacuation of the bowel and freedom from the anxiety of leakage. He wishes to be able to carry on his daily life in much the same way as he was accustomed to do before operation. His part in the management can be carried out in one of two ways:

1 Training the bowel to act regularly of its own accord in order to have a daily action.

2 Washing out the bowel regularly every day.

In the part played by the surgeon it is of great importance that certain essentials should be remembered in the formation of the colostomy and in the management of the postoperative period. This

will lead to easy management and avoid complications.

1 There is a choice of three positions for the stoma: at the left ilium, at the rectus sheath and possibly at the epigastrium. Colostomies in all of these positions appear to work equally well.

2 The formation of an adequate spur is essential. A glass rod is popular, easy to apply and very satisfactory. The rod or a substituted rubber tube should remain in position for 3 or 4 weeks.

JOHN J. MURPHY, M.D.

BUTTS, J. B., and CONLEY, J. E.: Perinephric Abscess; Report of 3 Cases Simulating Acute Appendicitis. *U. S. Army Med. Bull.* 1945 45 1087.

In the differential diagnosis of any abdominal pain, one should consider perinephric abscess, although it is uncommon. The syndrome of obscure fever with pain in the right flank and abdomen due to perinephric abscess may be easily confused with acute appendicitis and lead to a deleterious appendectomy. The authors report 3 cases simulating acute appendicitis.

A perinephric abscess is an infection outside of the kidney capsule with resultant necrosis of the perirenal connective tissue and suppuration in the renal fossa. The cases presented were simple perinephric abscesses as contrasted to complicated abscesses associated with pathological kidney changes. Authorities differ in opinion as to whether all perinephric abscesses are secondary to some infection in the kidney.

Abdominal exploration may be undertaken when the clinical picture of perinephric abscess simulates acute appendicitis, and when urinary abnormalities are absent as they were in these 3 cases. Often there is a history of a skin infection or a severe upper respiratory infection several days or even weeks before the onset of the first symptoms. In these 3 cases no such history was elicited, although in case 3 a severe back injury occurred prior to the onset of the symptoms.

Anorexia, fatigability and night sweats are early complaints, followed usually by chills and fever. Pain in the right flank radiating to the costo-vertebral angle and to either of the upper or lower quadrants may be the earliest specific complaint. The 3 patients in this report all had pain in the right flank radiating to the right lower part of the abdomen. Simeone reported that lesions involving the perinephrium anteriorly cause pain in the right lower abdominal quadrant. Atcheson reported that 16 of 117 patients with perinephric abscess presented with complaints of lower abdominal pain, and 8 of the 16 had associated abdominal rigidity. Urinary symptoms are uncommon in cases of simple perinephric abscess.

On physical examination the patients are acutely ill and may show evidence of weight loss if the disease is prolonged. Most of them have tenderness in the right flank, and spasm and swelling are often present also. Simeone reported 3 of 34 cases with

tenderness present in the right lower quadrant only. Scoliosis with the concavity toward the affected side due to paravertebral muscle spasm is a prominent sign of perinephric abscess. Secondary inflammatory involvement of the psoas muscle may cause the patient to hold the hip flexed. Motion of the hip then causes severe pain.

Positive x ray signs such as obliteration of the psoas shadow, enlargement of the kidney shadow, concavity of the spine toward the side of the lesion, decreased movement of the kidney and diaphragm on respiration and displacement or distortion of the kidney or ureters may help to make the diagnosis. Only 45 per cent of the cases show positive x ray signs, so too much emphasis should not be placed on negative findings.

In simple perinephric abscess the urine is normal unless there is some kidney abnormality. The presence of albumin and white blood cells in the urine indicates gross involvement of the kidney itself. The staphylococcus aureus is most commonly cultured from simple perinephric abscesses while in complicated perinephric abscesses secondary to renal calculus and infection the *Escherichia coli* is found. Chemotherapy before operation may be responsible for negative cultures in some cases.

Prompt surgical drainage is the treatment of choice and leads to dramatic improvement in the symptoms. If the perinephric abscess is complicated a primary or secondary nephrectomy may be necessary. Usually the disease is far advanced when the diagnosis is made, 12, 7 and 8 days respectively, intervened between the admission of the patient and operation in the reported cases.

There was no mortality in the reported cases of simple perinephric abscess while mortalities of from 14 to 50 per cent were encountered in cases of complicated perinephric abscess.

ROBERT R. BLOOM, M.D.

LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

Nigam, K. S., and Sircar, J. K.: An Additional Test Helping in the Diagnosis of Chronic Cholecystitis. *Ind J Surg* 1945 7 95

Patients with chronic cholecystitis show marked cholesterol retention. The authors estimated the cholesterol in separated serum for which they used the colorimetric method. In most of the cases the estimation was done on an empty stomach in order to eliminate the dietetic factor. The estimation was carried out on 86 cases.

The minimum figure was 73 mgm. in a child aged 10 years and the maximum was 350 mgm. in an old man of 60 suffering from an enlarged prostate with secondary vesical calculus therefore the average was 145.9 mgm. The table shows the amounts of serum cholesterol within certain limits in the cases. In this series of cases the reading is higher than that found in the whole blood in India by other workers but it approaches the readings in other countries.

Serum Cholesterol	N of cases	Percentage
Below 100 mgm.	4	4.7
Between 100 and 119 mgm.	13	17.4
Between 120 and 139 mgm.	35	40.1
Between 140 and 179 mgm.	17	18.8
Between 180 and 200 mgm.	10	11.6
Between 200 and 220 mgm.	5	5.8
Above 220 mgm.	2	2.3

The ingestion of food rich in cholesterol for some time has been known to produce an increase in the blood cholesterol. It has been the aim in the present work to study the changes in the amount of cholesterol in the blood of human beings after a single ingestion of fatty diet and to compare them with the changes so obtained in patients with cholecystitis. At the very outset it may appear that the test of giving fatty diet may not be safe in cases of cholecystitis but fortunately in this series of cases no complications or trouble occurred. The diet which has been prescribed does not contain such an excess of fat that it upsets the patient, but it has enough cholesterol in it to make the estimation desirable. The test need not be done in cases of acute cholecystitis in which the diagnosis is obvious. It is certainly very helpful in the obscure and chronic cases. In acute cases the test should be applied after the acute symptoms have subsided and the patient is allowed solid diet.

It was found that 11 of 12 cases showed the maximum rise in the cholesterol level was below 80 mgm. only in 1 case the figure was high. The average was about 52 mgm. Seven cases of gall bladder disease could be studied and of these 6 were cases of chronic cholecystitis and 1 was a case of cancer of the gall bladder as proved on the operating table. In 3 cases the cholesterol metabolism could be studied both before and after operation and it was noticed that the rise in the level was not so high after the operation of removal of the diseased gall bladder. If tables are compared after the diseased organ is removed from the body in cases of cholecystitis the metabolism curve again becomes low like that of other normal people. It can be judged by comparing the graphs of patients who have been operated upon. If the rise of cholesterol is between 100 and 150 mgm. the case is probably one of cholecystitis, but if the rise is more than 150 mgm. one should be inclined to think it is a case of cholecystitis and this adds to the existing methods of confirming the diagnosis of chronic cholecystitis.

By comparing the tables one is forced to think that the marked rise in the level of the serum cholesterol in the table shown herewith is certainly due to the diseased condition of the gall bladder. In all of the first 6 cases the rise was more than 100 mgm. the minimum being 106 mgm. the maximum 188 mgm. and the average 161.5 mgm. The seventh case was that of a cancer of the gall bladder and in this the rise was only 75 mgm. although the fasting serum cholesterol was 300 mgm. and was due to jaundice. It is only in the chronic inflammatory conditions of the gall bladder that a marked rise in the level of

serum cholesterol occurs in the case of a new growth this was not noticed.
CHARLES BARON, M.D.

Ottoman, R. E., and Baker, J.: Metastatic Staphylococcal Infection of the Gall Bladder. *West J Surg* 1945 53 361

The authors report 2 cases of empyema of the gall bladder as a complication of simple superficial staphylococcus infections. One was secondary to a felon of the thumb and the other followed a sac excision of boils. Staphylococci were cultured from the gall bladder in each case. One gall bladder contained stones but no stones were found in the other.

In each patient the diagnosis was difficult because of red cells, pus cells and staphylococci in the urine. In 1 patient a severe pyelonephritis intervened between the boils and the cholecystitis. In the other a peritoneal infection was suspected but it was not proved.

Cholecystostomy was done in each case and resulted in recovery.
EARL O. LATIMER, M.D.

Milgram, P. L.: The Cystic Duct in Biliary Lithiasis (Il condotto cistico en la litiasis biliar). *Prensa med. argent* 1945, 31 2149

The author describes the normal anatomy and histology of the cystic duct and variations of the position of the duct under pathological conditions.

Mucosities of the cystic duct may be caused by an abnormally high resistance of the sphincter of Oddi, increased mucous secretions of the extrahepatic ducts, dilatation and hypertrophy of the wall of the cystic duct.

The cystic duct may be entirely absent and in such cases the gall bladder empties itself directly into the common duct. The cystic duct may also form a junction with one of the hepatic ducts, usually the right. A double cystic duct has also been described. The cystic duct may be adherent to Hartmann's pouch. Cases of primary carcinoma of the cystic duct have been reported in the literature.

A dilatation of the distal portion of the cystic duct comparable with a river estuary may be the sequel of stenosing inflammation or functional disorders of the sphincter. Such formation is of practical importance because a ligation of the cystic duct may produce traction on the opposite wall of the common duct and lead to an interruption of the biliary flow.

Under normal circumstances the cystic duct forms an acute angle with the hepatic duct. As a result of a gallstone formation this angle may become more pronounced and interfere with the bile flow to the gall bladder. Paroxysmal crises accompanying the resulting anatomofunctional hepatic syndrome may become quite serious and may produce jaundice. Sclerosis of the biliary ducts in such cases distorts the normal anatomy and there is great danger of inadvertent ligation of the right branch of the hepatic artery.

Clinical diagnosis of primary carcinoma of the cystic duct is impossible. As a rule the condition is mistaken for cholelithiasis.

Biliary fistula of the cystic duct after an operation is usually due to a stone formation between Heister's valves. Occasionally a biliary phlegmon of the abdominal wall, without a stone formation, may lead to the formation of a fistula of the cystic duct.

Lithiasis of the cystic duct is a rare condition. Intermittent is observed in about one-third of all the cases.

An inflammation of the stump of the cystic duct following cholecystectomy without a stone formation is relatively frequently responsible for postoperative pains.

Neuromas in the wall of the cystic stump may be responsible for postoperative pains. A dilatation of the stump of the cystic duct may be followed by a concomitant dytonia of the sphincter of Oddi. Some times such conditions require a choledochoduodenostomy.

In selected cases abnormalities of the lumen of the common duct may be corrected by the implantation of the cystic duct into the duodenum in order to side track the bile flow. The operation may be considered in some cases of incipient stenosing pancreatitis.

The author advocates preservation of the cystic duct after cholecystectomy not only to facilitate operative cholangiography but also to create a safety valve in cases in which an incomplete obstruction of the distal third of the common duct is present.

JOSEPH K. NARAY, M.D.

Dameshek, W., and Miller, E. B.: The Megakaryocyte in Idiopathic Thrombocytopenic Purpura, a Form of Hypersplenism. *Blood J* 1946 946 27

The megakaryocytes of the sternal bone marrow were studied at biopsy in 12 cases of idiopathic thrombocytopenic purpura and compared with those of 10 normal individuals, of 5 cases of thrombocytopenic purpura associated with various types of splenomegaly and of a large group of miscellaneous hematological conditions associated with a reduction in platelets including leucemia.

Megakaryocyte counts expressed in terms of a million nucleated red cells and differential counts of megakaryocytes were made. The megakaryocytes were classified as megakaryoblasts, promegakaryocytes and mature forms, and were further subdivided into those showing granular platelet production, degenerated forms, and mitoses.

In the normal individuals, not more than 300 megakaryocytes per million nucleated red cells were present, and an average of 68.6 per cent showed platelet production. In the case of acute idiopathic thrombocytopenic purpura although the platelets in the circulating blood were rare, the megakaryocytes were increased being present in a proportion of from 366 to 743 per million nucleated red cells. However platelet production was greatly diminished and found in from only 8 to 19 per cent of all megakaryocytes. Following splenectomy, there was a striking increase in the platelet production, which was now present in from 69 to 85 per cent of all the cells, and the large masses of new platelets in the

marrow were often very striking. In the cases of chronic idiopathic thrombocytopenic purpura the megakaryocytes were considerably increased over the normal values but showed great diminution in platelet production following splenectomy. Extreme degrees of platelet production from the megakaryocytes took place. In splenomegaly of nonleukemic origin (cirrhosis, splenic vein thrombosis, Gaucher's disease, Felt's syndrome) the megakaryocytes were somewhat increased but platelet production was normal. In aplastic anemia, lymphosarcoma, acute leucemia and other diseases invading or destroying the bone marrow, the megakaryocytes were conspicuously reduced, the few remaining cells being of normal morphology.

The findings of increased megakaryocytes and greatly diminished platelet production in the marrow before splenectomy and the striking increase in platelet production after splenectomy indicate a definite pathogenetic relationship of the spleen to the disease. Idiopathic thrombocytopenic purpura is probably a form of hypersplenism (splenic thrombopenia) in which, through a possible hormonal mechanism, the megakaryocytes of the bone marrow are inhibited from normal platelet production and delivery. The marrow findings in idiopathic thrombocytopenic purpura are sufficiently characteristic to be of diagnostic value in differentiating the disease from leucemia and other conditions associated with a low blood platelet count. HAROLD LAUFMAN, M.D.

MISCELLANEOUS

Etcheverry, M.: Postoperative Eventration through the Anterolateral Abdominal Wall (La eventración postoperatoria en la pared anterolateral del abdomen). *Rev. méd. quir. pos. fem. B. Afr.*, 1945, 13, 395.

The frequency of eventration remains approximately the same from year to year; it occurred in about 2.5 per cent of all laparotomies according to the author's statistics. Three main factors responsible for eventration must be considered: (1) organic deficiency of the patient, either local or general, (2) technical errors, and (3) postoperative complications which interfere with normal restitution of the tissues.

Four conditions of the abdominal wall can be distinguished in the discussion of disruption of the abdominal wound: the hypertonic and hypotonic abdomen and the strong and weak abdominal wall.

Eventration occurs mostly in the anterolateral portion of the abdomen at the site of the fusion of the superficial and deep aponeurosis.

As far as the operative technique is concerned, 3 points are essential: (1) adequate exposure, permitting easy access and manipulation of the organs to be operated on, (2) proper selection of the zone of the abdominal wall, allowing perfect reconstruction, and (3) selection of the direction of the incision with regard for the integrity of the muscular fibers and nerves.

A transverse incision seems to be logical because it is parallel to the blood vessels and nerves. Particular care must be exercised when catgut is used as suture material.

The author mentions three frequent causes of disruption of the abdominal wall: (1) a subcutaneous or subaponeurotic hematoma attributable to insufficient hemostasis, (2) infection of the wound, and (3) the introduction of a drain into the abdominal cavity. The irritating effect of a foreign body such as a drain is intensified by contamination of the abdominal wound by infected fluids escaping from the peritoneal cavity.

The author prefers a double knot to a triple knot because of the facility of tying and a lesser amount of foreign body left in the wound. If a triple knot is used, catgut is usually tied twice in the same direction and the last time in the opposite direction. The author prefers tying the knot in alternating directions. He also maintains that a continued suture approximates the tissue better than interrupted sutures. JOSEPH K. NARAT, M.D.

Colp, R., and Druckerman, L.: Subtotal and Palliative Gastrectomy for Chronic Gastric Ulcer. *Surgery*, 1945, 18, 573.

A series of 42 consecutive patients suffering with chronic gastric ulcer treated surgically is presented. The duration of the disease varied from several months to 40 years. The patients were admitted to the surgical service only when the pain was becoming more severe despite adequate treatment, when an intractable pyloric stenosis was evident, when hemorrhages had become recurrent, and when the presence of a carcinoma was suspected. In the series of 42 cases of benign ulcer, the roentgenologist reported 3 cases as being highly suggestive of neoplasia. Of 22 cases in which the gastroscopist could visualize gastric ulcerations, 5 were pronounced malignant but were subsequently proved to be benign. An absolute achlorhydria was present in 12.

The preoperative preparation of such patients, many of whom are in poor general condition, is outlined. At present the authors prefer continuous spinal anesthesia combined with sodium pentothal intravenously since it provides the best relaxation and exposure with a minimal amount of retraction. Exploration is carried out through a median epigastric incision and the operation of choice is subtotal gastrectomy of the Hofmeister type. If the lesion is so massive that resection appears impossible, preliminary jejunostomy seems a logical procedure to put the stomach at partial physiological rest and cause regression in size of the ulcer so that partial gastrectomy may be performed several weeks later with comparative ease and safety. The stomach is usually removed in a retrograde manner, and antecolic anastomosis using a short proximal loop of jejunum about 6 inches long is performed.

In 9 cases in which either a very high gastric resection had been performed or in which a marked

preoperative dilatation of the stomach increased the possibility of postoperative gastric atony a complementary jejunostomy for alimentation was done. There were 6 cases in which the antrum and pylorus were removed, but the ulcer was left *in situ*. The so-called palliative gastrectomy has not had wide application and has one major disadvantage—the lesion which is not removed may possibly be carcinomatous. On the other hand removal of the antrum and pylorus of patients suffering from gastric ulcer almost always results in anacidity so that recurrent gastric or gastrojejunal ulcer is almost unknown.

The indications for palliative gastrectomy in this series were penetrating ulcer high on the lesser curvature or ulcers juxtaesophageal in location. The general physical condition in 4 patients was so poor that an excessively high resection necessary to remove the ulcer would have been extremely hazardous.

The postoperative course and complications are described. In the series of 49 consecutive gastrectomies for gastric ulcer there were 2 deaths.

JOHN L. LONGQUET, M.D.

Poth, E. J., Ross, C. A. and Fernandez, E. B.: An Experimental Evaluation of Sulfasuxidine and Sulfathiazidine in Surgery of the Colon. *Surgery* 1945 18 529.

The study made by these authors shows sulfasuxidine and sulfathiazidine to be valuable adjuncts in surgery on the colon of the dog. The indications are that the so-called aseptic methods of anastomosis should be used whenever possible, but it is evident that an open technique may be undertaken with a considerably increased degree of safety. These observations support the satisfactory results obtained when man is treated in a similar manner.

The reaction, as revealed by the amount of edema of the omentum adherent to the line of suture, is significantly less when the bacterial flora is modified by the administration of the drugs. The most clearcut evidence of the value of these drugs is revealed by the results which followed the method of open anastomosis, wherein no effort was made to prevent fecal soiling of the operative field. Even though the degree of spillage was much greater following the administration of sulfasuxidine because of the semifluid nature of the contents of the bowel, there was a striking difference in the operative mortality and morbidity. Forty-three per cent of the control animals died of generalized peritonitis due to disruption of the line of suture. One hundred per cent of the control animals showed gross leakage at the line of suture. These observations are in contradistinction to absence of death and lack of gross leakage through the suture line when the animals had received sulfasuxidine and sulfathiazidine. Furthermore in the control experiments there was acute inflammation and little evidence of healing and repair by the fifth postoperative day. Following drug therapy the inflammation had subsided and

the tissues had undergone orderly repair and healing.
BENJAMIN GOLDMAN, M.D.

Patton, E. F.: Proctological Problems of the Pediatrician. *J. Pediatr.*, S. Louis, 1945 27 532.

The etiology of constipation, painful defecation, frequent small stools, and bleeding per rectum in infancy and childhood is often an abnormality or a disease of the anus or rectum which can be determined by proctologic examination.

A frequent cause of constipation in early infancy is an incomplete dissolution of the membranes between the blindgut and the proctodeum. This may be manifest at birth, but may not develop to a degree of marked obstruction for days or even weeks. The opening may be adequate at first, but as time goes on, folds of mucosa of the segment of rectum above the constriction overlap across the lumen, thus forming a valve. A stenosis, in the form of a diaphragm or ring of tissue, can be overcome by one or more gentle dilations with a lubricated, rubber covered finger.

The usual cause of painful defecation is an anal fissure or an area of proctitis. In an infant or small child an electric otoscope using a large speculum serves as a useful proctoscope. Anal fissures are readily visible. Proctitis is seen as a red, congested area of mucosa contrasting with the pale pink, normal tissue around it. A regimen to produce small soft stools is necessary to heal a fissure or proctitis. This involves the establishment of two regular toilet times daily: the occasional use of a suppository or enema, the intake of generous quantities of water, stewed fruits and vegetables, the temporary use of combinations of agar and mineral oil by mouth, and anesthetic ointments locally. The healing of fissures and proctitis is aided by the topical application of silver nitrate.

Frequent small but otherwise normal stools may be caused by anal fissure, proctitis, or a local dermatitis. The latter may be due to a fungus infection, pinworms, scabies, cryptitis or papillitis. The treatment of this complaint is dependent upon the cause.

The many causes of bleeding per rectum are well known. The causes of rectal bleeding visible through the proctoscope are fissure, proctitis, polyp, or ulcer (nonspecific or amebic).

Prolapse of the rectum may be caused by a polyp, but it is usually due to a redundant mucous membrane. In the immediate treatment concern should not be so much for prompt reduction as for permanent retention after reduction. If prolapse is allowed to persist for hours, or even until spontaneous reduction with simple recumbency takes place, the resulting edema and local submucous reaction is helpful in producing thickening and fibrous tissue which will help in permanent retention if the stools can be kept small and smooth enough to pass easily while mucosal edema is subsiding. Various methods are proposed for maintaining reduction, such as continued recumbency, elevated hips, or

strapping the buttocks together with adhesive tape. The anti-constipation regimen as outlined before must be instituted concurrently. If conservative treatment fails to prevent recurrences a sclerosing solution may be injected in the submucous tissues.

Although megacolon is not primarily a proctologic problem, some cases can be relieved by systematic rectal dilatation with graduated dilators.

Perirectal abscess, fistula in ano and hemorrhoids in childhood are managed as in later life.

ERNEST E. ARNHEIM, M.D.

Alecha J. M., Carpanelli, J. B. and Ferreira J. A.: Amebic Abscess of the Liver Opening into the Peritoneal Cavity (Absceso amebiano hepático abierto en cavidad peritoneal). *Rev. As. Méd. Argent.* 1943 59 1043

Amebic abscess of the liver is the most frequent localization of amebiasis outside of the intestine. An analysis of 14,907 cases of amebiasis showed hepatic abscess clinically in 4.86 per cent but autopsy showed it in 36.6 per cent.

The diagnosis is often not made until perforation occurs although a careful study of the history should give indications of the true diagnosis. X-ray examination may show malformation of the liver especially of its diaphragmatic surface and may also show peritoneal effusion. Rectosigmoidoscopy may be useful in showing dysenteric ulcers. In 90 per cent of the cases the pus in the abscess is aseptic. Amebae are much more apt to be found in tissue curetted from the walls of the abscess.

A case is described in a man of 37 years in whom the diagnosis was not made until operation although he had a rather typical history. He had been treated in a clinic 3 years before however and

neither laboratory nor roentgen examination had given any indication of the true diagnosis. When he was admitted with the picture of acute peritonitis a diagnosis of perforated acute cholecystitis was made. Operation showed the true condition and the abscess was evacuated and emetin treatment begun. The amebae disappeared from the feces after the first series of emetin and the patient made an uneventful recovery.

Although the pus of the abscess was aseptic the diagnosis of its amebic character was made from the lack of any history or evidence of pyogenic infection, the macroscopic appearance of the abscess and its contents, the relative seriousness of the case and the slight postoperative peritoneal reaction, the presence of the vegetative forms of amebae in the feces after operation, and the course of the disease.

Some surgeons use emetin intraperitoneally during operation, but the authors do not believe there is any logical indication for its use in this way.

AUDREY G. MORGAN, M.D.

Brunschwig, A.: Radical Resections of Advanced Intra Abdominal Cancer. *Ann. Surg.* 1945 122 923

Progress in supportive treatment of the surgical patient permits of the extension of radical surgical attack upon advanced abdominal cancer. Experiences in a series of 100 patients revealed that effective, albeit in some instances brief palliation was afforded in 35 per cent and an appreciable and prolonged palliation was achieved in an additional 15 per cent of the series. Given adequate conditions, a more radical attitude in the surgical treatment of advanced abdominal cancer would appear justifiable.

CHARLES BARON, M.D.

UTERUS

Curtis, A. F.: *Observations on Certain Rheological Properties of Human Cervical Secretion*. *Proc. R. Soc. B. Lond.* 1945 39 1

Cervical mucus like most other secretions of the body is not a true fluid because it does not flow at a steady rate under constant pressure. Further more when pressure is increased the rate of flow does not increase proportionately. Such secretions are complex systems characterized by properties such as anomalous viscosity, elasticity, flow-elasticity, Spinnbarkeit and adhesiveness. A study of such physical properties is called rheology.

Experimental evidence and numerous clinical observations suggest that the rheological properties of human cervical mucus undergo a cyclic variation in the menstrual cycle and furthermore bear direct relation to ovulation to penetrability of cervical mucus by spermatozoa and to pregnancy.

This author has directed his attention primarily to the study of two hitherto unrecognized rheological properties of cervical mucus—namely, flow elasticity and Spinnbarkeit. When a material showing flow elasticity is caused to flow along a tube and the pressure is suddenly released the material recoils towards its original position. This property is accurately measured in the meniscoscope, an instrument which consists essentially of a graduated glass capillary tube. One end of the tube is open, the other fits tightly on to a syringe. A small side tube for the control and sudden release of pressure is interposed between the syringe and the main tube.

Spinnbarkeit is the capacity of liquids to be drawn into threads. The most suitable English term now available is "viscosity". It is a property of cervical mucus and is capable of accurate measurement. The test is carried out by drawing away a cover slip placed on a blob of mucus and measuring in centimeters the thread thus produced.

The author stresses the following points as a prerequisite of interpretation of result:

1. The cervix must be healthy, with no pathological tear, marked erosion or endocervicitis.
2. Contamination with blood should be reduced to a minimum.
3. The specimen must be collected from the cervical canal not from the vaginal vault or from the external cervical os.
4. Neither douching nor coitus must have taken place during the 48 hours preceding collection.
5. No antiseptics should be used in collecting the sample.
6. The test for flow-elasticity (elastic recoil) should be performed within 30 minutes of collection of the sample.

The cervical mucus of 26 women showing normal menstrual cycles was studied. Seven of these women

were seen more than once, 3 were studied for at least one complete cycle and 2 became pregnant during observation. Flow-elasticity and Spinnbarkeit were measured. The amount of mucus secreted, the macroscopic appearance and the number of leucocytes contained in the specimen were also noted. These properties were carefully correlated with the time of the menstrual cycle or pregnancy and they supply two new rheological tests.

A rheological test for ovulation in woman is described. The sample of cervical mucus is runny and homogeneously translucent. Flow-elasticity and Spinnbarkeit are maximum. The cellular content is minimal. At this time penetrability and longevity of spermatozoa are greatest.

A rheological test for pregnancy in woman is described. The sample of cervical mucus is thick and homogeneously opaque. The mucus is difficult to draw into the meniscoscope and there is almost complete absence of flow-elasticity and Spinnbarkeit.

These rheological phenomena and tests should prove of value in the recognition of ovulation and anovulatory cycles in the investigation and treatment of some forms of sterility (cervical hostility) in various types of ovarian dysfunction, and in application as accessory tests for pregnancy.

L. J. MITCHELL M.D.

Curtis, A. F.: *Hypertrophy of the Uterus*. *Br. J. Obst.* 1945 50 742.

The usual symptoms of hypertrophy of the uterus are prolonged or excessive menstruation, pelvic pressure with more or less aching discomfort, and increased vaginal discharge.

Examination reveals an enlarged uterus which is usually heavy, often retrodisplaced, and difficult to differentiate on bimanual examination from adenomyosis of the uterus or diffuse enlargement from deeply buried myomas. Differentiation from carcinoma of the body of the uterus is sometimes difficult, occasionally even after examination of uterine curettings in the cases of hypertrophy with marked endometrial hyperplasia.

Histological diagnosis of the various types of uterine hypertrophy is facilitated by differential stains. With routine hematoxylin and eosin stain, enlarged and thickened blood vessels and the amount of perivascular connective tissue are readily recognized but accurate determination of the relative proportion of connective tissue and muscle cells is not simple. A trichrome stain similar to the Masson stain helps to solve this difficulty.

The more enlarged uterus is studied the more apparent it becomes that various gradations of hypertrophy are encountered in most instances and that pure subinvolution or true diffuse hypertrophy or hypertrophy due solely to metritis or to endocrine disturbance is unusual.

Curetage may be required for differential diagnosis, and strangely enough, it is sometimes beneficial. If more important surgical intervention is required, one should hesitate to perform corrective operations for uterine displacement in these cases unless childbearing is an important issue. Removal of the offending organ by subtotal or complete hysterectomy is the procedure of choice.

EDWARD L. CORNELL, M.D.

Waterman, G. W., and DiLeone, R.: Treatment of Carcinoma of the Cervix with Interstitial Radium Needles at the Rhode Island Hospital. *Am. J. Obst.* 1945 50 483

The authors report first the 10 year survival rates on 309 cases from 1926 through 1933 which were previously reported for five year survivals second they add a new series of 198 cases which passed through the Clinic from 1934 through 1938 and third they review the total of 507 cases from 1926 through 1938.

An improvement in the results in the last three years from 1936 through 1938 in 127 cases is shown.

The effect of age on the extent of growth when first seen (clinical stage) and on the prognosis (five year survival rate) is shown.

The incidence of adenocarcinoma, carcinoma complicating pregnancy, bone metastases, generalized metastases, and cancer primary in a second organ is given for this series.

TABLE 1—SURVIVAL RATE BY YEARS 1 TO 10 FROM 1926 TO 1933—309 CASES

Stage	(Schultz) per cent	No. cases	5 Y survival per cent	10 Y survival per cent
I	4.8	5	71	7
II	3.7	95	51	20
III	35.6	1	16	3
IV	27.0	86		
Composite	100	309	50	59
Relative		5	100	100

TABLE 2—FIVE YEAR SURVIVALS—127 CASES FROM 1936 TO 1938 LAST 3 YEARS

Stage	(Schultz) per cent	No. cases	Yr.	Y	5 Y	4 Y	3 Y	5 Y per cent
I	2.3	5	3	3	3	3	3	100.0
II	30	38	34	20	27	27	26	69
III	48	61	47	30		5	5	64.3
IV	19.7	5	8	3	3	3	3	4
Abscises	100	137	87	63	54	3	30	59.3
Not treated	14.3	18						
Relative	89.7	109					40	44.9

13 cases—needles not used as primary method. One treated elsewhere survived 3 years.

The good results previously reported from the use of interstitial long platinum needles of low intensity are maintained in this series and with the added use of x ray therapy in the last consecutive 109 treated cases, are definitely improved.

Through a more carefully worked out distribution and spacing of the radium sources as suggested by a study of dosage and five-year survival rates it is hoped that these results may be further improved.

EDWARD L. CORNELL, M.D.

ADNEXAL AND PERIUTERINE CONDITIONS

Ziegler, E. E.: Bilateral Ovarian Carcinoma in a Female 30 Weeks Old. *Arch. Path. Chlc.* 1945 40 270.

This is a case report of a carcinoma which apparently was a dysgerminoma arising from granulosa cells in a fetus weighing 1,340 gm. and estimated to be thirty weeks old.

At the routine autopsy the ovaries were slightly enlarged and grayish pink in color. They aroused no special interest during the autopsy and the tissues were removed and sectioned routinely. Histological examination, however, showed that the entire substance of each gland was practically replaced by carcinomatous tissue. The cancer cells contained numerous mitotic figures. Scattered through the neoplasm were numerous primitive granular follicles. In some places the granulosa cells seemed to show stages of transition into neoplastic cells. This gave the impression that the tumor was a granulosa cell carcinoma. The tumor cells themselves, however, resembled those of dysgerminoma, and there was a delicate tumor stroma between the masses of tumor cells which also resembled the stroma of the well known dysgerminoma. There were no gross or microscopic evidences of extension or metastases.

The mother of this infant is living and well and has since given birth to a full term well developed, normal appearing infant.

The occurrence of neoplasia in childhood in infancy and now in fetal life seems to lend weight to the opinion of those who believe in the importance of hereditary as opposed to environmental factors in the causation of cancer. It seems to indicate that at least some cancers may occur without the operation of extrinsic environmental factors.

SAMUEL J. FOCKLSON, M.D.

MISCELLANEOUS

Grellet, H. E.: The Use of Prostigmine in the Treatment of Amenorrhoea and as a Pregnancy Test (De l'emploi de la prostigmine dans le traitement de l'amenorrhée et comme test de grossesse). *Rev. f. gyn. obst.* 1945 40 250.

Emmenagogues such as apol ergot, and yohimbine were formerly used to start menstruation because they produced congestion in the pelvic organs. They have been replaced by sexual hormones but recent studies again focus attention on

the rôle of hyperemia in the mechanism of menstruation. It has been shown that hormones produce histological transformation of the uterine mucosa which the older drugs were not able to cause, but the ability to create hyperemia and uterine bleeding is common to both groups of drugs. Estrogenic hormones have a double effect: (1) a specific action and (2) a nonspecific action related to the phenomenon of hyperemia. Both male and female sexual hormones display a vasomotor effect, attributable to the ability to liberate a certain amount of acetylcholine which acts on the blood vessels through the parasympathetic system. Acetylcholine is produced *in situ* and not in remote places. Such effect is of short duration, not exceeding 12 hours, because a hydrolytic disintegration of the acetylcholine occurs under the influence of the enzyme cholinesterase present all along the nerve fibers.

Many authors consider that the menstruation results from a vasodilating reflex comparable with erection. Retardation of the menstruation without apparent cause may be attributed to a nervous factor responsible for an insufficiency of the vascular response with a glandular system intact. To remedy such conditions prostigmine has been suggested instead of acetylcholine because it acts on the parasympathetic system by inhibition of the cholinesterase without the dangers associated with acetylcholine. In this manner a rapid disintegration of acetylcholine in the tissues is inhibited and thus a uterine hyperemia is facilitated.

The author employed prostigmine in 86 patients and could check the results in 75. A menstrual delay

of from 5 days to several weeks was recorded in the histories. The material consisted of 30 cases of pregnancy, 10 nonpregnant cases in which endocrine or organic disorders could be excluded and the amenorrhea had to be considered as accidental, and the remainder in which the patients had probable or manifest endocrine disorders.

The author concludes from his investigation that three consecutive injections of prostigmine in women who usually have a normal menstruation are followed by bleeding, usually typical menstrual bleeding. In women in whom an organic or endocrine disorder is suspected such prompt result is considerably less frequent and usually appears only if the injections coincide with the luteal phase. No uterine bleeding occurs if amenorrhea is due to pregnancy. Therefore prostigmine injections may be used as an early diagnostic pregnancy test. If no bleeding follows 3 injections of prostigmine in patients without any evidence of endocrine or organic disorders, the possibility of pregnancy should be considered.

The patient should be informed that the injections will not provoke an abortion.

In 14 nonpregnant patients treated with prostigmine a bloody show appeared within 6 days after the last injection. In patients with amenorrhea postpartum the time which elapsed between the injections and the bleeding was long enough to create doubt as to the efficiency of prostigmine.

The author expresses doubt as to the efficiency of prostigmine in amenorrhea caused by endocrine disturbances.

JOSEPH E. NARAY, M.D.

OBSTETRICS

PREGNANCY AND ITS COMPLICATIONS

Bernstine, J. B.: Vaccination during Pregnancy as a Prophylaxis against Puerperal Infections
Med Clin N America 1945 29 1405

The investigator undertook to culture the type of organisms commonly found in puerperal infection test their effect on laboratory animals and by means of a vaccine made from the cultures, elevate the immunity of the pregnant woman to such infections.

Cultures were taken from the cervix and endocervix of pregnant women with a sterile cotton swab placed in a tube of blood agar and subcultured within 30 minutes. The culture media consisted of 5 per cent defibrinated horse blood agar plates, beef infusion broth, pH 7.6 and plain 2.5 per cent infusion agar plates and slants. The common organisms found were the staphylococcus albus streptococcus viridans the diphtheroids nonhemolytic streptococcus and bacillus subtilis.

After a vaccine was prepared as explained in detail in the original article 3 groups of mice were inoculated with various strengths of the vaccine. Following the study on mice, 10 female patients in the childbearing period were selected. No reactions occurred in this group therefore 475 patients attending the maternity clinic at Jefferson Medical College Hospital Philadelphia, were inoculated. There was no particular selection of the patients and later at the time of delivery it was not revealed which patients had been inoculated.

The initial injection was 1 minim with subsequent injections of 4, 8, 12 and 16 minims. The number of injections varied from 8 to 30. The majority of patients received their injections from the fourth to ninth month. There was a noted absence of reactions in these women.

In this series of vaccinated patients, 4.2 per cent were morbid during the puerperium as compared with the nonvaccinated group whose morbidity was 17.1 per cent. This study concluded a series of 973 patients who were vaccinated 503 having been reported upon in preceding papers.

CATHERINE B. HIRS M.D.

Duran, A.: Axial Torsion of the Myomatous and Pregnant Uterus (Torsion axial del utero mioma toso y gravido) *Bol Soc chilena obst gin* 1945 10 119.

Axial torsion of the myomatous and pregnant uterus is very rare. The author has found only 2 cases in the literature before he encountered the one reported in this article. This case was in a woman of 35 years who was found to have a nodular myoma of the uterus complicated by a pregnancy of 12½ months. The myoma was removed the denuded surface covered with bladder peritoneum and the wound sutured. The woman made a complete re-

covery and the pregnancy continued without interruption. The other 2 cases are reviewed briefly.

The name axial torsion is not really correct as this would indicate a torsion of the whole organ around its axis while as a matter of fact there is a rotation only of the body of the uterus around the supravaginal part of the cervix which is lengthened and softened by the existing conditions. The rotation may be to the right or left and may be as much as 180 degrees, so that the anterior surface of the uterus looks backward. Torsion of a nonpregnant myomatous uterus may be as much as 360 degrees. Factors in the torsion are the weight volume and site of implantation of the tumor and the softening and elongation of the isthmic portion of the uterus brought about by the pregnancy. The torsion causes a sudden intense pain irradiating over the whole abdomen, accompanied by syncope a small rapid pulse vomiting cold sweat, and dyspnea. The temperature is normal and there is dissociation between the pulse and temperature. Abdominal palpation reveals muscle rigidity and intense sensitiveness. In cases in which the torsion takes place gradually the symptoms are slight.

Operation should be performed as soon as the diagnosis is made. Detorsion is generally not difficult the uterus may be fixed in position by Passeron's hysteropexy or Pentalosa's pelvic hysterectomy the myoma removed and the denuded zones covered with peritoneum. If the torsion has caused serious circulatory disturbances such as extensive extravasations of blood infarcts or zones of gangrene the uterus must be removed. If no great circulatory changes have taken place and the myomectomy has left the wall of the uterus in good condition the pregnancy may continue. However if the site of implantation of the myoma is very large or serious nutritive disturbances of the wall of the uterus have taken place the uterus may rupture.

AUDREY G. MORGAN M.D.

PUERPERIUM AND ITS COMPLICATIONS

Rosenblum, G. Melnikoff, E. and Fiat, H. S.: Early Rising in the Puerperium *J Am M Ass* 1945 129 849

The practice of early rising of parturient women dates back to ancient times. Although it was recently stimulated by the wartime shortage of obstetric beds it did not arise from that emergency. The puerperium or time of rest given to women in childbirth has varied more widely in the customs of different peoples than any other feature of that great physiological function of woman.

The practice of early ambulation of surgical patients now a widely accepted procedure and advocated by hundreds of articles in the American and foreign literature must be considered intimately

related to the practice of early puerperal rising. The objectives and underlying principles of the two are identical.

With a background of favorable evidence in the literature the task of studying early ambulation in the puerperium was begun. At the outset it was realized that there would be objections both from patients and from the medical profession to the practice of early ambulation. The following objections arose during the course of their study.

The objections of doctors were (1) fear of medical-legal consequences, (2) fear that episiotomies would break down (3) fear that there might be too much strain on the pelvic floor resulting in prolapses and retroversions, (4) fear of excessive postpartum bleeding and (5) fear that patients would not approve of early rising.

The objections of the patients were (1) that the procedure was unfamiliar to them, therefore they were not sure it was good (2) that they needed rest and it might tire them too much to get up (3) that they were too weak to walk, (4) that arising might make them bleed too much and (5) that they might break their stitches.

A group of 532 obstetric patients who were studied were divided into three groups as follows (1) 247 early risers ambulatory on the first or second postpartum day (2) 106 intermediate risers, ambulatory on the third or fourth postpartum day and (3) 229 late risers ambulatory later than the fourth postpartum day.

The study of bladder function showed a close similarity of the catheterization curves for the three groups. The contention that early puerperal rising may cause excessive bleeding is disproved by the statistics, which show actually less frequent abnormal bleeding in the early group than in the late group. Involution of the uterus was uniformly good in all groups. The fear that early rising would cause a breakdown of episiotomy or abdominal wound incisions is likewise unfounded, only 1 instance of perineal skin separation occurring in the entire series, and this in a patient in the late rising group. More efficient mobilization of the bowels was evident as more than three times as many spontaneous bowel movements occurred in the early as in the late group.

The total number of complications in the entire series was very small, and there was no significant difference among the three groups. As there were no patients having emboli or thromboses in the entire series, the contention of many previous authors that late rising fosters these complications was not proved in this series. However a study of a much larger series might possibly reveal a lower incidence of these complications in the early risers.

The claim advanced by some obstetricians that early rising may cause later prolapse and retroversions is also disproved. Of the early risers examined at 1 month and at 6 weeks 28.7 per cent had either a midposition or retroversion of the uterus, while

34.6 per cent of the intermediate and 24.4 per cent of the later risers had the same positions—relatively similar totals. This indicated that early rising causes no significant alteration in the position of the uterus, at least within a period of from 4 to 6 weeks following delivery. Prolapse did not occur in any patient in the entire series.

The nurses working in the obstetric department reported a decided reduction in the amount of nursing care required for patients rising early. They noted better morale and less discomfort in this group.

Particularly favorable are the reports concerning cesarean sections in which cases less abdominal distention and discomfort, and a much more rapid convalescence was noted.

No patient in either the early or the intermediate group offered any criticism concerning the early rising. In fact, the majority exhibited enthusiasm. The multiparas especially were impressed, stating that they felt better and stronger than they had after previous confinements, when they had spent a period of from 7 to 14 days in bed.

CHARLES BARTON, M.D.

MISCELLANEOUS

Van Wageningen, G.: The Optimal Mating Time for Pregnancy in the Monkey. *Endocrinology* 1943, 37: 397.

Since the rhesus monkey (*macaca mulatta*) is the laboratory animal of choice for the study of the physiology in reproduction, any knowledge concerning the optimal mating time for pregnancy is of considerable interest.

The author reports on a series of observations extended over a 5 year period on monkey breeding. During this study a rigorously standardized plan for mating at a particular time in the menstrual cycle was used.

The routine procedure was to place the female on the eleventh day of her menstrual cycle in the cage of a male for a period of forty-eight hours. Thirty-two per cent of such matings resulted in pregnancy. Another forty-eight hour mating starting on the thirteenth day of the menstrual cycle resulted in pregnancies in 24 per cent of the cases.

Another series of 35 monkeys were studied and their mating date was delayed to the seventeenth day of the menstrual cycle. These animals were mated more than an average of three times each, eighty times in all, but at the end of 4 months only 1 pregnancy had been effected. In contrast, when the remaining 24 monkeys then were mated on the eleventh day of their next cycle 7 of them became pregnant.

The author concludes that in this particular monkey the period between the eleventh and thirteenth days of the menstrual cycle is the preferred time for mating.

HARRY FIELDS, M.D.

GENITOURINARY SURGERY

ADRENAL, KIDNEY AND URETER

Huggins, C. B., and Scott W. W.: Bilateral Adrenalectomy in Prostatic Cancer. *Ann Surg* 1945 122 1031

Abundant use of plasma transfusions seems to be of great importance in the prevention of circulatory collapse following adrenalectomy in man.

The author states that inadequate therapy after adrenalectomy in man results in early hyperpyrexia and hypotension, the carbohydrate metabolism is not drastically disturbed. In the adrenalectomized man adequately treated with plasma, adrenal cortical extract, and desoxycorticosterone acetate these effects were not observed, but Addisonian pigmentation occurred on the sixteenth postoperative day and was progressive.

Complete adrenalectomy in castrate man results in a reduction of 17 ketosteroids to values less than 3 mgm. excreted in the urine daily, total ketonic, and α fractions are greatly diminished. Urinary androgens as measured by the comb-growth technique are absent. There is a continued excretion of small amounts of estrogen. In a man who survived complete adrenalectomy for 116 days there was a sustained reduction of alkaline phosphatase activity of the serum but the prostatic cancer progressed although apparently at a retarded rate. The injection of desoxycorticosterone acetate elevated the blood pressure to normal levels but hypertension did not occur with massive doses.

The extragonadal androgenic depot in man is the adrenal.

Adrenalectomy is not a practical method of treatment of the failure-group of patients with prostatic cancer treated by antiandrogenic methods.

Three factors, whose presence and significance vary in the human prostatic cancers may be stated: (1) the testicular androgens (2) the extragonadal depot and (3) androgen-dependence or its opposite androgen independence. It is not yet possible to define androgen-dependence or independence in chemical terms.

JOHN A. LOYER, M.D.

Horta, J. S.: The Question of Origin of Grawitz Tumors (El problema del origen de los tumores de Grawitz). *Arch. Espan. Urol* 1945 2 115

There is no unanimity of opinions as to the origin of Grawitz tumors but at present there is more and more tendency to accept the renal theory. Modern biological studies of the functions of tumors originating in endocrine glands justify a revision of the older theories pertaining to the origin of Grawitz tumors.

A priori we may consider Grawitz tumors as originating from a normal structure of the adult kidney. Apparently such neoplasms do not derive from intrarenal inclusions of the suprarenal glands. There are arguments based on morphologic and bio-

logical considerations which tend to show that hypernephroma does not originate from aberrant suprarenal glands within the kidney.

Undoubtedly there is a great microscopic similarity between such tumors and the suprarenal cortex. In many cases it is impossible to distinguish microscopically a hypernephroma from the suprarenal cortex in both, the fat and glycogen are present in very small amounts or they are absent entirely. Cellular protoplasm is scanty and fusiform formations are present. Ewing maintains that nododifferentiated cells frequently found in a suprarenal carcinoma, are not present in the renal glands.

Sarcomatous structures may be present in Grawitz tumors as well as in the suprarenal cortex. The author shares Ewing's opinion as well as that of Apitz who maintains that both Grawitz tumors and those of the suprarenal cortex may have a sarcomatous structure which derives from epithelial cells, the renal epithelium and that of the suprarenal glands are of mesothelial origin.

Frequency of papillae and lucid spaces is characteristic for parenchymatous tumors of the kidney while in corticosuprarenalomas they are very rare. Such formations in suprarenal cortex tumors are of glandular origin. Under low power both kinds of tumors may look identical but under high power cells of renal tumors show a typical vegetative aspect only the exoplasm is stained while the remaining cytoplasm remains colorless. Large fat droplets may be seen in sections of Grawitz tumors stained with Sudan III while the droplets are very small in corticosuprarenalomas. The vegetative aspect of cells in renal tumors is caused by the accumulation of glycogen. That cellular formations are practically reduced to cytoplasm in corticosuprarenal tumors cannot be denied but according to the author's opinion such images are secondary.

The fact that hypernephromas do not produce alterations of the sex characteristics of the host is interpreted by some writers as an argument against the suprarenal theory. Not all tumors of the suprarenal cortex are accompanied by such modifications. From the hormonal point of view the cortical tumors may be divided into (1) those which do not produce hormonal changes (2) those which are accompanied by an excess formation of estrogens, (3) those with a symptomatology related to the excessive production of metabolic steroids and (4) those accompanied by an increased excretion of androgens and steroids. To the author's knowledge not a single case of renal hypernephroma with virilism has been reported in the literature.

The presence of numerous vacuoles in suprarenal tumors but not in hypernephromas is stressed.

Contrary to the rarity of aberrant suprarenal nodules of the kidney aberrant Grawitz tumors are relatively frequent.

The author believes that there are sufficient arguments in favor of the theory which claims that Grawitz tumors do not originate from suprarenal tissues.

Renal hypernephroma belongs to the group of neoplasms of the endocrine glands characterized by the presence of lucid cells such as benign cortico-suprarenal tumors, leucomas or hypernephromas of the ovaries, tumors of the interstitial gland of the testes, and parathyroids.

Hypernephromas of the kidney are sometimes accompanied by hypertension but it has been pointed out that no definite relations exist between these two conditions. Hypertension may persist after nephrectomy has been performed on account of the presence of a Grawitz tumor.

Hypernephromas possibly originate from myo-epithelial formations described by Goormaghtigh, who considers them as regulators of the circulation within the glomeruli. JOSEPH K. NARAT M.D.

Santaella, R. A.: Voluminous Pyonephrosis and Its Treatment (Las pñeufrosis vol minosa y su tratamiento) *Arch. esp. med.* 1945: 2.

The author advocates a nephrectomy in two stages in the treatment of extensive pyonephrosis. His clinical observations and anatomopathological studies demonstrated the advisability of such staged procedure. Perifocal sclerotic reaction safeguards against a spreading infection by establishing a defensive blockade. Usually 1 month is allowed to elapse between the first stage which consists of nephrostomy and insertion of a Pezzar catheter and the second stage the nephrectomy proper. The operation is performed only if the functional capacity of the kidney is good. The hilus is ligated en masse. Frequently the author leaves a clamp on the pedicle for 3 weeks.

Six cases in which two stage operations were performed are described in detail.

JOSEPH K. NARAT M.D.

Castro, E. P.: Renal Tuberculosis (Tuberculosis renal) *Arch. esp. med.* 1945: 59.

The author reports a case of renal tuberculosis in a 34 year old man who had repeated attacks of pain in the hypogastrium, combined with a great frequency of urination. The pains would disappear after the application of heat. The last attack was complicated by an intensive hematuria with blood clots, chills and fever. All the symptoms disappeared after the administration of pyridium. Three months later the patient was admitted to the hospital. X-ray studies disclosed a dense homogeneous, well circumscribed shadow extending from the right hilum region to the diaphragm. There was a clear space in the center of the shadow. Hematological and bacteriological studies established the diagnosis of pulmonary abscess. The patient was treated with short waves.

The expectoration and fever subsided and the second roentgenogram showed evidence of cicatrization of the pulmonary abscess and the existence of

bronchiectasis in the right lower lobe. The patient complained of vague pains in the left renal region and the epigastrium. The urine contained a large amount of pus. Chromocystoscopic examination showed a normal function of the right kidney while after the injection of indigocarmine only very pale fluid was escaping from the left ureter. Retrograde pyelography showed a large cavity above the upper calyx, with irregular outlines after intravenous urography an image of the cavity in the left kidney was obtained.

A nephrectomy was performed with great difficulty on account of adhesions around the upper pole of the kidney. The patient made an uneventful recovery.

The histological examination revealed a tuberculosis of the kidney with numerous Langhans' giant cells, epithelial cells and lymphocytes. There was an intensive sclerotic reaction. The glomeruli had undergone a hyaline degeneration. Extensive necrotic zones were spread throughout the entire renal tissue in the involved region.

The symptomatology and the roentgenographic studies pointed to a renal neoplasm. The inspection of the extirpated kidney also suggested a tumor rather than renal tuberculosis.

A check-up 3 years later showed the patient to be in perfect health. JOSEPH K. NARAT M.D.

Gorro, A. P.: Partial Nephrectomy (Nefrectomia parcial) *Arch. esp. med.* 1945: 29.

A partial nephrectomy is indicated when a circumscribed area of the kidney is involved the remaining parenchyma appears normal, and the excretory pyeloureteral portion is not affected. An extensive mutilation of the organ in such cases is not justified.

Partial nephrectomy advocated by a number of older writers, was later discredited on account of operative or postoperative hemorrhages, and the formation of obstinate urinary fistulas which required an ultimate extirpation of the organ. For these reasons, improper indications such as the presence of a malignant neoplasm or of tuberculosis of the kidney also discredited the operation.

Recent advances in urological diagnosis, such as urographic studies, and improvement of the technique rehabilitated the operation.

Experiments on animals show that a portion of the renal parenchyma corresponding to one-fourth of the entire amount of both kidneys is sufficient for the survival of the animal. An extirpation of a portion of the kidney does not unfavorably alter but rather improves, the function of the remaining part of the kidney.

A decision to resect only one part of the kidney cannot frequently be made until the surgeon is able to inspect the organ. Conditions of the blood supply and permeability of the pyeloureteral system are the most important factors to be considered. Aortic arteriography before the operation may furnish valuable information as to the blood supply to the

kidney. Pyelography furnishes information as to the condition of the excretory pyeloureteral apparatus.

Partial nephrectomy is indicated in a partial hydronephrosis located at one of the poles of the kidney. If lesions caused by a stone are extensive, a simple extraction of the calculus does not assure anatomic restitution of the involved parenchyma and in such cases a partial nephrectomy furnishes excellent results because it prevents an extension of the inflammatory process. A partial nephrectomy is indicated if a large solitary cyst is present.

If a hydatidiform cyst does not communicate with the excretory ducts, a partial resection of the kidney may be considered. If in a polycystic kidney the changes are confined chiefly to one portion of the organ, the affected area may be removed and the cysts disseminated over the surface of the kidney may be destroyed with the cautery.

Sometimes abnormal blood vessels interfere with pyeloureteral evacuation and in such cases a section of the abnormal blood vessels which may lead to an ischemia of the corresponding part of the kidney may be avoided by a prophylactic partial nephrectomy. Otherwise a septic necrobiosis may result.

If a destructive renal infection is confined to one portion of the organ, the affected area may be resected and a drain inserted.

Only on rare occasions is a partial nephrectomy indicated in renal tuberculosis. This may be the case if the infection affects a kidney with a double pyeloureteral system which permits a functional and roentgenographic study of both portions of the kidney. Such studies may reveal an integrity of one part of the kidney.

Anomalies of the renal pelvis with or without infection may show that two parts of the kidney function independently of one another. In such cases a plastic pyeloureteral operation, when there is a congenital anomaly may supplement a partial resection of the kidney. Such an operation may be considered if a benign neoplasm involves only one part of the kidney.

In many cases of injury of the kidney a partial resection of the organ is justified.

One of the drawbacks of a partial resection is the hemorrhage; this can easily be stopped with the electrocautery. The second drawback is the difficulty encountered in the determination of the extent of the lesion. Roentgenographic studies are extremely valuable in this respect.

A few essential points in the technique must be kept in mind. The blood vessels supplying the portion to be resected should be ligated prior to the resection, especially if one is dealing with an abnormal kidney. Many authors described a technique of approximation of the wound edges. However in many instances the wound in the kidney cannot be closed without an insertion of a flap consisting of muscle tissue and aponeurosis. Such portions of the tissues may be obtained from the external oblique muscle. Difficulties in approximating the edges are encountered when a transverse or a wedge shaped

incision is made in the kidney. The inserted musculoaponeurotic strip is kept in place with interrupted catgut sutures. The author uses interrupted catgut sutures for approximation of the edges which transfix the parenchyma and the fibrous capsule.

Efficient extrarenal drainage for from 8 to 12 days provides evacuation of the extravasated urine. Otherwise an infiltration of the soft tissues with abscess formation may result.

The author performed a partial nephrectomy on 16 patients. He encountered the following anatomic abnormalities: a superior polar artery, both superior and inferior polar arteries, double renal pelvis, and a normal kidney with a double pelvis and ureter. The following pathological conditions were found: pyelonephritic infection, hypoplasia with a complete double ureter, tuberculosis of a kidney with a double pelvis and ureter, congenital uretero-hydronephrosis with a double pelvis and ureter, infected hydronephrosis with a double pelvis, calculous pyonephrosis with a double pelvis, lithiasis with infection, tumor of the kidney, hydronephrosis, inferior polar artery, circumscribed dilatation of a calyx, and traumatic rupture of the kidney.

In 5 cases transparenchymal drainage of the renal pelvis was employed. In 4 cases the urine was escaping from the lumbar incision for a few days following the operation. In 2 patients the urinary discharge stopped spontaneously between the fifth and tenth postoperative days while in the remaining 3 cases the discharge lasted from 3 to 4 weeks. In 1 patient a urinary fistula opened and closed repeatedly for a few months until a small stone was expelled spontaneously. In 1 patient symptoms of an acute pyelonephritic infection developed. The condition was attributed to a premature removal of the intrarenal drain on the tenth postoperative day. Following the introduction of a ureteral retention catheter the infection subsided in 30 days.

JOSEPH K. NARAY, M.D.

Frostad H.: Urinary Stasis and Pains after Cystoscopy with Catheterization of the Ureters. *Acta chir scand* 1945 93 546

Frostad studied 95 cases in which preliminary intravenous pyelography excluded urinary tract calculi and in which pain or colic followed retrograde pyelography. After ureteral catheterization patients frequently complain of pain, and the urine from one or both ureters is bloody. Postcystoscopic intravenous pyelography demonstrated a characteristic urinary stain on the affected side. In 3 cases removal of a blood clot projecting from a ureteral orifice resulted in immediate cessation of the pain. In the series cases with reduced renal function were excluded.

Postureteral catheterization pain usually starts in one or both lumbar regions and in 2 to 3 hours gradually spreads downward along the course of the ureter to the inguinal regions. The pains may vary in intensity corresponding to ureteral peristalsis. They seldom begin quite suddenly as in calculous

colic, but begin and decrease gradually. They usually begin a few hours after completion of the cystoscopy. Of the 95 patients, 33 had postcatheterization pain. Pain usually occurred when blood was most excessive during collection of the ureteral catheter specimens. A fairly constant relationship between the intensity of the pain and the amount of bleeding during collection of the specimens was present.

Of the 33 patients with postcatheterization pain, 28 had intravenous pyelography immediately after commencement of the pain. In all cases more or less complete stasis on the affected side was found and the duration of the stasis varied from 1 to 6 hours. When the pains disappeared, the stasis disappeared at once. Among 19 cases without pain, intravenous pyelography did not demonstrate stasis in any instance. Other causes of stasis, such as cal-

culi ureteral rupture, gravidity adjacent tumors or abscesses, and allergic reactions would have been ruled out by the preliminary intravenous urography. The most probable cause of stasis is the formation of blood clots which for a time obstruct the ureter after ureteral catheterization.

DAVID ROSENBLUM, M.D.

Prince, C. L.: Lumbar Ureterolithotomy; The Foley Operation. *J. Urol.*, Balt., 1945 54 368.

The intention of Prince is to bring to the attention of the surgical profession the simple operation of lumbar ureterolithotomy which was introduced in 1935 by F. E. B. Foley. The author believes that this simple procedure with no cutting of muscles, without freeing of the ureter with ease of exposure, and with rapid convalescence has been neglected by the profession.

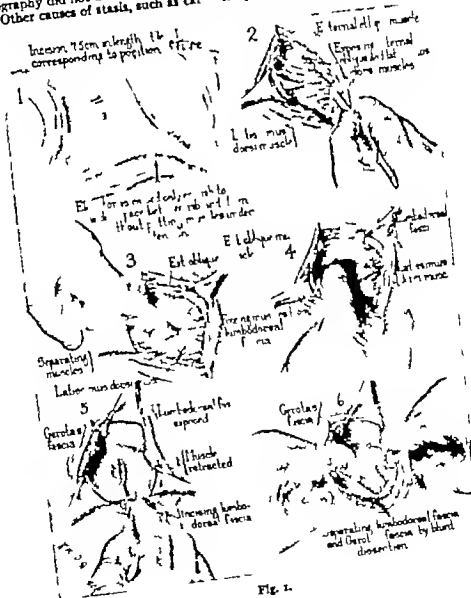


Fig. 1.

Details of the operative technique including excellent illustrations by Didusch are given (Figs. 1 and 2). Briefly exposure of the ureter in its upper third consists of making a short (7 or 8 cm.) incision parallel to the twelfth rib with the midpoint of the incision at the end of the twelfth rib and at a distance below the rib equal to the distance of the ureteral stone below the twelfth rib as determined with x rays. Dissection is carried downward to the lumbodorsal fascia by bluntly separating the latissimus dorsi posteriorly and the external and internal oblique anteriorly, and stripping these muscles from the lumbodorsal fascia below. The lumbodorsal fascia is then opened in the direction of its fibers and the fascia of Gerota stripped from its under surface. The posterior layer of Gerota's fascia is separated bluntly from the quadratus lumborum and psoas

muscles down to the vertebral bodies. At this point the ureter can be seen and opened the stone removed exploration made with bougies closure is easily accomplished. It consists of suture of the muscularis and perireteral tissues with interrupted fine catgut and then suture of the lumbodorsal fascia subcutaneous tissue and skin. A Penrose drain is placed for 2 or 3 days. The muscles do not require suturing.

Convalescence in these cases has been smooth. There has been no shock or mortality. The average hospital stay following the Foley operation in 14 cases reported by the author was 7 days. During the usual muscle splitting and cutting procedure for stones in the upper third of the ureter the average hospital stay in 14 comparable cases was 28.4 days.

WILLIAM W. SCOTT, M.D.

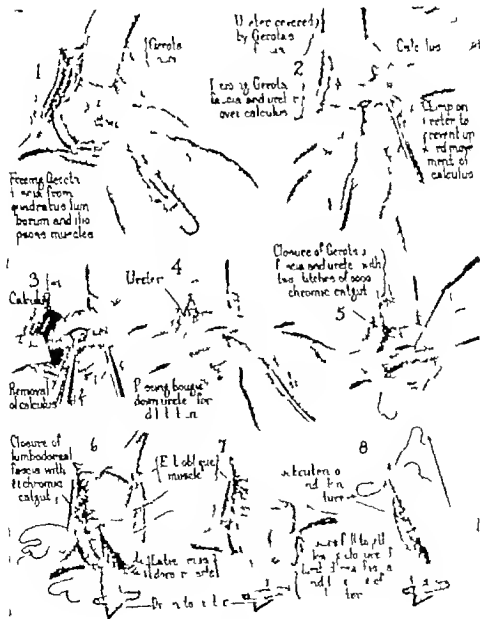


Fig. 2.

BLADDER, URETHRA, AND PENIS

Ballesteros, M.: Cystometry (La cistometría) *Rev med* 1943 3 206

After a brief historical review of cystometry and a short description of the anatomic, pathological, and physiological conditions of the bladder the author describes various models of apparatus used for cystometric measurements and the technique of cystometry.

Cystometry is of great importance for the discovery of disturbances of the bladder function of neurogenic type or those caused by a reflex from adjoining organs. The method is particularly valuable in cases in which locomotor ataxia is combined with hypertrophy of the prostatic gland.

The average figures obtained by the author differ somewhat from those published by North American workers. According to the author's investigation the pressure curve indicated a normal capacity of the bladder of from 150 to 300 c.c. The maximal voluntary pressure in normal individuals ranges from 38 to 62 mm. of mercury. In hypertonic individuals the capacity of the bladder is below 150 c.c. and the maximal voluntary pressure exceeds 62 mm. of mercury while in hypotonic individuals the bladder capacity exceeds 300 c.c. and the maximal voluntary pressure remains below 32 mm. of mercury. In normal individuals the curve ascends gradually while in hypertonic individuals it rises rapidly and in hypotonic patients it is low. The maximal physiological capacity of the bladder ranges from 200 to 700 c.c. Among cystometrographs, the one devised by Lloyd G. Lewis is the most precise instrument the electrocystometrograph of Landes and Vorn is also a dependable apparatus.

Sphincterometric measurements are also of great importance as they supplement cystometric studies.

The most complete cystometric apparatus is the so-called microcystometer devised by Irving Simons.

The author discusses various sources of error such as infection of the bladder, excessive rapidity of the injection of the fluid, rectocele, cystocele and diverticula of the bladder which may produce a hypotony of the detrusor muscle, stones in the bladder and tumors or infectious processes which may produce hypertonia. JOSEPH K. NARAT, M.D.

Leifer W., Martin S. P., and Kirby W. M. M.: The Treatment of Gonococcal Urethritis with Single Injections of Penicillin Beeswax Peanut Oil Mixtures. *J. Engl. med. J.* 1945 233 583

The procedure and materials used for the treatment of gonococcal urethritis were essentially the same as those described by Romansky and Rittman in 1914 (*Science* 100 106). The viscous preparation—even when heated in an incubator or in a water bath at 37 C for 30 minutes—was withdrawn into a syringe by a 15 gauge needle and then injected into the buttock through a 30-gauge needle. The site of injection was not massaged. No local or systemic

manifestations of toxicity of any significance were noted. In most cases pain and tenderness were present at the site of injection for from 24 to 48 hours, but these were no more severe than when penicillin in saline solution is used.

In every patient treated in this series clinical improvement was noted initially. Dysuria subsided during the first six or eight hours and the purulent discharge became mucoid and watery. By the end of the second day almost every patient was free of symptoms and the urethral discharge had ceased.

One hundred and ninety-two patients of the total of 217 whom the authors treated by this method could be followed up for 31 days and only these were considered in evaluating the results. In 24 of these treatment resulted in failure however there was a clinical recurrence with the return of urethral discharge, from which gonococci were cultured in only 10. In the other 14 the gonococcus was detected by bacteriological methods alone. All of the 24 patients in whom treatment was considered a failure were eventually cured by further penicillin-beeswax peanut oil therapy or by treatment with divided doses of penicillin in saline solution.

In reviewing these results, no noteworthy effects due to the character of the excipient used, e.g. the percentage of beeswax used, or the salt of penicillin employed (calcium or sodium) were noted, nor did the race of the patient (negro or white) make any difference, although the white patients were found to be slightly more refractory. Of the total 192 in the series who were followed up for 31 days, 83 were treated with 100,000 units of penicillin, and of these 74 (84%) were cured; 97 were treated with 300,000 units and of these 83 (91%) were cured. The remaining 13 patients were given 300,000 units and of these 11 were cured however the last group was too small to be significant.

From these results the authors conclude that a single intramuscular injection of 100 c.c. of a mixture containing 300,000 units of penicillin in 4 to 6 per cent beeswax by volume in peanut oil appears to be a highly satisfactory method of treating acute gonococcal urethritis. JOHN W. BRIDGMAN, M.D.

Gastro E. P.: Epithelioma of the Urethra; Nodular Form (Epithelioma de uretra form nodular). *Arch. esp. med.* 1945 140.

The author collected 18 cases of epithelioma of the urethra from the literature and reports a case of his own in a man, aged 48 years, who had noticed an enlargement of the glands 8 months prior to the admission to the hospital. Simultaneously a hemorrhagic secretion began dripping from the meatus. Gradually burning pains developed and were responsible for impotence because they were interfering with erection.

There was a very marked phimosis. Palpation showed the glands to be transformed into a globular hard mass, painful to the touch. The local temperature was increased. A sanguinous secretion was escaping from the urethra. A catheter could not

be introduced because it was encountering a mass just behind the meatus. The testes and epididymes were normal and no enlarged inguinal glands could be palpated. The Wassermann reaction was negative.

A biopsy was performed and the examination of the piece removed from the endourethral mass established the diagnosis of a spinocellular epithelioma.

An operation was performed under low spinal anesthesia. The involved portion of the penis was removed. An inspection of the specimen showed the entire navicular fossa to be occupied by a cauliflowerlike neoplasm.

Histological examination showed a malignant neoplasm consisting of the squamous type of epithelial cells which were penetrating the skin and forming numerous ramifications and anastomoses. The stroma was relatively scant. A hyaline degeneration of the epithelium was noticed in many places and there was evidence of a chronic inflammatory reaction in the stroma in the form of an infiltration with plasma cells, lymphocytes, and a few polynuclear cells. Mitoses were relatively few.

Urethral epithelioma usually causes severe pain which interferes with micturition and sexual power. The frequency of urination may be increased or a complete retention may develop. The latter may disappear when necrosis of the tumor re-establishes free passage. As a rule symptoms of penurethritis accompany the induration. In doubtful cases a urethroscopic examination may be required. Biopsy allows the differentiation of an epithelioma from adenomatofibroma, fibroma, or fibromyoma while serological examinations exclude syphilitic lesions. Inguinal adenopathies are relatively frequent.

Chronic inflammatory strictures, fistulas, and leucoplakia are considered as predisposing factors. In 60 per cent of the cases the tumor has been found in the perineal portion of the urethra.

The tumor may be either nodular or infiltrating. Both types show a considerable peripheral growth. Necrosis of the tumor tissue may lead to the formation of perurethral abscesses.

Metastases are found in the inguinal epigastric and mesenteric regions.

Cylindrical cell formations or adenocarcinomas deriving from Littre's glands are rare and in the majority of cases a squamous-cell tumor is found. This is due to the frequent metaplasia of cylindrical urethral epithelium.

The therapeutic method of choice is an amputation of the penis if the epithelioma is located in the anterior urethra. Involved inguinal glands should be removed. A removal of the testes is superfluous because they have an entirely independent lymphatic circulation.

The prognosis is much worse if the epithelioma involves the posterior urethra, while chances of cure are reasonably good if the tumor is confined to the anterior portion.

An early diagnosis is essential

JOSEPH K. VARAT, M.D.

GENITAL ORGANS

Boyd, H. L. The Use of Thrombin (Topical) in the Control of Bleeding Associated with Prostatic Surgery. *J. Urol. Balt.* 1945 54 385

Boyd suggests the topical use of thrombin for the control of bleeding during and following perineal prostatectomy in the cases in which bleeding cannot be controlled by ligation of the bleeding points and the supplementary use of the Davis bag and gauze packing. In his introductory remarks Boyd reviews the previous successful use of thrombin by O. Conner in cases of excessive hemorrhage following transurethral electroresection and suprapubic prostatectomy.

In 12 cases of excessive bleeding following perineal prostatectomy in which control by ordinary means proved impossible thrombin was used. The technique is given in detail and consists briefly of the application of a gauze sponge (3 inches long) soaked in thrombin solution (5,000 units in 20 cc. of normal saline solution) to the bleeding areas within the prostatic capsule, the sponge being brought out of the wound beside the Davis bag.

In 1 case in which the Davis bag became partially deflated and passed into the prostatic bed, profuse bleeding was controlled by clamping the Davis bag introducing the thrombin solution through the urethra, clamping the urethra and permitting no irrigation and no catheter drainage for a period of 4 hours.

In 1 case excessive bleeding was controlled with thrombin introduced and localized to the prostatic space by means of the Trattner partition catheter.

WILLIAM W. SCOTT, M.D.

Millin, T.: Retropubic Prostatectomy: a New Extravesical Technique. *Lancet* Lond. 1945 249 693.

The outstanding features of retropubic prostatectomy are:

1. It is an extravesical procedure by which suprapubic bladder drainage with its risk of slow closing or persistent fistula is avoided.

2. It is applicable to all types of prostatic obstruction.

3. It is relatively short and shock free.

4. It appears to be anatomically sound, no important organs being interfered with or endangered.

5. The mortality is singularly low. No deaths have occurred in the first 20 cases.

6. The postoperative course is easy for the patient and attendant staff.

7. The whole of the obstructing tissue is removed so the risk of recurrent obstruction is obviated.

8. The postoperative stay in the hospital seldom exceeds 2 weeks.

Preoperative treatment. When the signs or symptoms suggest the necessity or desirability of operative intervention the usual preliminary tests of renal and cardiovascular functions are made. Particular emphasis is laid on preliminary intravenous

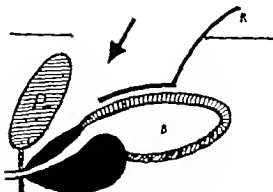


Fig. 1. Retropubic approach to the prostate: P, pubis, B, bladder, R, retractor

urography. From this study is ascertained evidence of ureteric dilatation, unexpected gross hydronephrosis, vesical diverticulum, urinary calculi, and approximate residual urine without the necessity of urethral instrumentation. When actual retention has supervened suprapubic puncture is being tried initially with a small hydrocele trocar and cannula, and repeated when necessary until renal function studies have been made. When the initial puncture reveals infected urine, a No. 8 rubber Fiemann catheter is passed per urethram and retained *in situ*. When the urine is uninfected and renal function adequate urethral instrumentation is not used before the patient is on the operating table.

Operative technique. The patient having been anesthetized either by low spinal anesthesia, with pentothal, or with pentothal and gas-oxygen, as indicated a rapid cystourethroscopic examination is made to rule out unexpected bladder pathology and to study the exact configuration of the gland. The bladder is emptied, and while the surgeon is changing his gloves and gown, the assistant prepares the operative field, i.e. the lower abdomen and penis. The penis is covered with a loose sterile towel. A midline incision is made starting over the pubis and extending upward $3\frac{1}{2}$ or 4 inches, according to the obesity of the patient. This is deepened in the usual manner and the sponeurosis is incised in the whole length of the wound. Bleeding points are caught in hemostats and coagulated with the diathermy needle. The recti are then separated in the midline and the index finger inserted at the lower extremity sweeps the retropubic fat and peritoneal fold upward. A modified Harris self retaining retractor is then introduced. The lateral blades keep the recti widely separated and the posterior blade presses the bladder upward and backward (Fig. 1).

A flexible lamp resting on the pubis is dipped into the retropubic space thus opened up and the distribution of the veins coursing upward on the anterior and lateral aspects of the prostate is noted, as this appears to vary considerably. The veins are situated in the prevesical layer of the endopelvic fascia. The central leash arising from the deep dorsal vein of the penis is under-run with the boom-

erang needle and ligated. The group on each side is similarly treated. The fat still adherent to the lateral aspects of the gland is gently sponged downward and outward, any veins inadvertently torn in this process being promptly seized with hemostats and subjected to diathermy. The anterior and lateral surfaces of the gland being cleared in this way a medium sized swab is pushed into each lateral recess.

With a diathermy knife or No. 15 Bard Parker knife a curved transverse incision, convex downward, 1 cm distal to the bladder neck, is made through the prevesical fascia and true prostatic capsule. Suction is maintained to keep the field dry and to enable the operator to grasp any bleeding vessels in the distal lip with curved Kocher forceps. With these forceps used as tractors the lower flap is undermined toward the apex of the gland with Devine's long dissecting scissors. The Kocher forceps are removed after being touched with the diathermy needle. The upper flap retracts because of the pull of the severed pubovesical muscles. The anterior and much of the lateral aspects of the false capsule now being exposed an inverted V incision is carried down to the adenoma, which is readily recognized by its typical whitish appearance. The V shaped flap is elevated, which opens up a loose shaped space. With the closed curved dissecting scissors the lower margins of the lateral lobes are freed from the false capsule. The dissection may be continued with the scissors, or, as the author prefers, with the finger. For this purpose it is best to remove the retractor temporarily. The lateral lobes and when present, the middle lobe, are freed digitally from below upward until they present in the wound, being attached solely in the region of the bladder neck. The pedicle is seized on each side with Kocher forceps and the adenomatous mass is detached with scissors or the diathermy needle. The forceps are touched with the diathermy needle and removed. In 1 instance only has a steady finger in the rectum been necessary.

The retractor is now replaced the field swabbed and sucked dry and the edges of the false capsule are secured with 4 pairs of Allis forceps. By traction on these and suitable manipulation of the flexible lamp and sucker the prostatic bed is carefully inspected. The two prostatic arteries, if not already secured in the pedicle, are easily seen bleeding close to the bladder neck at 5 and 7 o'clock. They are seized with hemostats and coagulated. Any other obvious bleeding vessels are similarly treated. This exposure enables one to see large or small adenomas not infrequently left behind during enucleation by any route. They are detached with scissors.

Bleeding having been controlled, the towel covering the penis is then raised and a No. 18 Harris catheter passed along the urethra into the prostatic cavity and thence guided into the bladder. With the assistant steadying the Allis forceps on the margins of the false capsule, the operator closes the defect with a continuous suture of No. 0 catgut, using the boomerang needle. The transverse incision

In the true capsule is then approximated over this with 3 or more interrupted No. 0 catgut sutures. All obvious bleeding should now have been controlled. The lateral recess packs are removed, the field is gently swabbed dry of clot and sprayed with sulfanilamide powder, and a small corrugated drain is placed down to the suture line. The self retaining retractor is removed and the rectus sheath closed with interrupted No. 2 catgut sutures. The skin is closed with silk worm gut. Bilateral vasectomy is then performed. The catheter is next irrigated with 1/5000 flavine to free it from any clot it may have collected during its passage through the prostatic bed. Four ounces of fluid are left in the bladder and the catheter is spigoted. Two silk worm sutures fix the catheter to the skin of the penis. A 4 foot length of sterile tubing with a glass connection of even bore is then attached to the catheter, the lower end of the tubing being spigoted. The operation time need not exceed half an hour and is often nearer 20 minutes.

JOHN A. LOER, M.D.

MISCELLANEOUS

Cordonnier J. J.: Vesicoureteral Reflux Accompanied by Renal Colic. *J Am Med Ass.*, 1945 129 662.

The role of vesicoureteral reflux in the production of renal colic was brought to our attention by Lewis and Carroll in 1934. All cases described by them were secondary to vesical neck or urethral obstruction, and the typical renal colic occurred in the presence of a distended bladder when the patient attempted to void.

Diagnosis is established by filling the bladder with an opaque solution, taking an x ray film, having the patient void, and then taking a second film.

The etiological factors are: (1) mechanical obstruction of the vesical neck with upward dilatation and alterations of the ureteral orifice due to chemical, inflammatory and postoperative changes; (2) patent ureteral orifices associated with nerve lesions as in cauda equina lesions; and (3) congenital urethral valves.

Two cases with typical renal colic caused by vesicoureteral reflux are presented.

Vesicoureteral reflux should be suspected in cases of renal colic, particularly if no stone is demonstrable and vesical neck obstruction is present. Postoperative ureterovesical valve closures may be followed by vesicoureteral reflux. A routine cystogram alone may cause a reflux to be overlooked, and a second film, taken after the patient has voided, should be taken.

DAVID ROSENBLUM, M.D.

Marshall C. J.: Tubercle Bacilluria. *Brit J Urol.*, 1945, 17 103.

While a series of 11 cases is much too small for statistical analyses it may however bring out a few points of particular interest.

The presenting symptoms of these cases of tubercle bacilluria were the classic triad found in urinary

tuberculosis but in addition the importance of the node in the epididymus was fully borne out. Whether every case of chronic epididymitis should be subjected to full urinary investigation remains for discussion. It would seem however that there is one unequivocal indication—the examination of the twenty-four hour specimen for cells and bacilli. This simple but nevertheless searching test should never be omitted. Open tuberculosis cannot fail to make itself evident at least by the presence of leucocytes, if not of bacilli; the presence of either or both, of course, calls for the full roentgenographic investigation with cystoscopy.

There remains the case of closed tuberculosis in which cells are not found in the twenty-four hour specimen. Such cases must be uncommon but nevertheless they are on record. Such cases will be missed unless excretory roentgenography at least is performed.

The overwhelmingly important question however is that of treatment. In view of the evidence that small lesions do heal, even with calcification, it seems that there is strong justification for a policy of conservatism. Urinary tuberculosis is not a fulminating condition on the whole it is only slowly progressive and further vesical lesions, in general, present a high degree of recovery once the renal disease is removed. The progress of the condition lends itself to very precise observation; again, repeated examinations of the twenty four hour specimen provide clear indications for repetition of the cystoscopic and roentgenographic investigations.

Therefore it seems that if conditions in general are favorable and the patient is co-operative in the matter, so-called expectant treatment is permissible. Only one further point is to be emphasized that is, how permanent is the healing of renal tuberculosis? It will be noted that even in this small series there were cases in which healing occurred only to break down later on, and it was common experience in nephrectomy for gross tuberculosis to find areas of calcification indicating healing in the remote past, with recurrence of extensive destruction. It may nevertheless still be argued that in view of these considerations—case of control and slowness of progress—the tendency to later breakdown still does not invalidate the soundness of the conservative attitude in simple bacilluria. There was little support for it in the cases presented. Gross tuberculosis was found in each one submitted to nephrectomy and in 3 the old healing had broken down again of the conservatively treated cases 2 developed gross renal tuberculosis and in the others tubercle bacilli were still present in the urine.

JOHN A. LOER, M.D.

Ward, R. O.: Some Surgical Aspects of Urinary Bilharziasis. *Proc R. Soc. Med. Lond.*, 1945 39 27.

Bilharziasis is a disease which produces many important changes in the urinary tract and is of only for that reason worthy of the interest of urologists.

Examination of the urine. The most general method of making a diagnosis of bilharziasis hematuria is to examine the last drops of urine passed or the centrifuged deposit of the urine of the patient under a $\frac{3}{8}$ inch or $\frac{1}{8}$ inch objective. No staining is required. The ova with their terminal spines are easily recognized. In the late stages the sclerosed bladder may be palpable in an emaciated patient, and per rectum extensive induration may be found to involve the prostate and vesicles and all tissues at the bladder base and in the perineum.

The importance of cystoscopy in diagnosis. (1) A solitary examination of the urine for ova is a quite unreliable test, for ova are not continually released from the lesions of the mucosa. (2) Five consecutive morning specimens, the last few drops of the urine being collected and centrifuged will show either ova or red blood cells in about 85 per cent of the cases the latter being strong evidence in the mass examination of natives that bilharzia is present. (3) Even in the absence of ova or red blood cells the continual presence of pus or albumin in a native's urine means that a diagnosis of bilharzia is probable until it has been disproved. (4) Cystoscopy is the most accurate method of diagnosis in all active phases of bilharziasis. Moreover there are several characteristic vesical changes which persist when the active stages of the disease are past. It may be argued that cystoscopy does not reveal lesions of the kidneys and the urethral mucosa that must be admitted but it is probably very rarely that these tissues are affected without vesical involvement.

Cystoscopic appearances in renal bilharziasis. The earliest abnormality seen in the bladder mucosa is the appearance of patches of congestion which occur most commonly in the trigonal region these, however have no characteristics which enable a certain diagnosis to be made. Subsequent stages are specific.

The first of these stages is very typical. Bilharzial tubercles make their appearance. Each of these is about as large as the tubercle due to Koch's bacillus (to which it bears some resemblance) that is to say about the size of a pin's head. It is raised above the level of the mucosa and is surrounded by a narrow ring of congested vessels. It has a shining surface and a faintly yellow color. As it grows and dies the shine diminishes, and the yellow color remains and is sometimes intensified while the surrounding hyperemia becomes less or may disappear entirely. The bladder mucosa which lies around a collection of these tubercles is sometimes congested but it may be very little different from the normal. When an intense invasion by ova is in progress very marked bullous edema is often produced. It is difficult to say how much of this is a mere reaction to the ova and their toxins, and how much of it is due to venous blockage by the worms, but probably the former is the more important cause.

Calcification of the bladder tissues around the ova is a prominent feature in all severely infected long standing and untreated cases.

One local result of calcification is what is called sandy patches in the mucosa.

The process of calcification affects chiefly the sub-mucosa layer of the bladder wall. It is by no means necessarily accompanied by secondary infection, and on cystoscopy in such cases the bladder has often been clean. When this was the case it was usually very pale because of sclerosis and diminution of the vessels. This calcification forms a barrier in which many ova perish and through which others cannot work their way.

Another stage is the development of a bilharzial ulcer. This may be clean and without sloughs. It is usually single and Makar says that he has never seen this type of ulcer become malignant. More often secondary infection is coexistent, and in such cases an ulcer also usually a solitary one, has a sloughing base and marked cystitis is present.

Vesical papillomas due to bilharzia are common in Egypt. This is a true neoplastic condition and frequently malignant. In that country cancer of other organs is uncommon, and these growths are considered to be the result of the toxins of the ova. A bilharzial papilloma unlike a granulomatous mass with which it sometimes may be confused, is, of course, not to be cured by medical treatment. These growths do not have long fronds but are of firm consistency. Usually there are only 2 or 3 of them. The commonest variety of bilharzial papilloma met with in Egypt is of bulbous form and dark red color although in parts it has a grayish white appearance due to septic necrosis and to phosphatic deposits in the growth. These growths may spread and in rare cases involve the greater part of the bladder. Nodular infiltrating carcinomas are less common. In the series of 130 cases, 10 were of this variety. This variety has the characteristics with which we are familiar and follows the course common to all bladder carcinomas of this type.

In untreated cases the musculature of the bladder which is the seat of this disease, tends to be thickened partly because of hypertrophy and partly because of fibrosis due to the additional development of prostatic and urethral obstruction, resulting from bilharzial changes in those tissues. Despite such obstruction the bladder in these cases often remains contracted and this renders suprapubic cystotomy very difficult or impossible. Urinary fistulas which are a direct result of the disease produce the same result. They affect all parts, but particularly the floor of the urethral bulb and are often so numerous and extensive that when the male patient squats to micturate the perineal effect resembles the spraying from the rose of a watering can. These fistulas sometimes track widely.

Vesical calculi are met with in bilharziasis and in rare cases the ova have been found within the stones. These calculi appear to be composed of uric acid and oxalates, and are formed upon debris. Phosphatic calculi are very common when sepsis has become severe. Renal calculi are also encountered, although they are very much less frequent.

Ureteral obstruction of moderate degree is often encountered during the active stage of the disease. In such cases it will disappear when a course of treatment with antimony has had time to kill the worms and thus cause the acute reactive processes to resolve.

Chronic ureteral stricture is a very important and frequently insidious result of bilharziasis which we must be prepared to diagnose and to treat. It affects the lower parts of the duct for the upper portions lie in an area which is but rarely invaded by the worms. Most of the various pathological conditions which arise in the venical mucosa may also be encountered in the ureters, but stenosis is the common complication. Although it may sink into relative insignificance in the clinical picture of a native affected by advanced urinary bilharziasis, yet in such patients death from infected bilateral hydrophrosis is common. These strictures however are encountered in patients who appear at first sight to have recovered completely from the disease.

Dilatation of an established stricture of the ureter is best effected through an instrument of the McCarthy panendoscope type with some form of stiff ureteral dilator. Such a method when possible is very effective, more so it seems than in any other types of ureteral strictures and although the case requires further supervision the cure is often complete.

The author does not discuss the general treatment of urinary bilharziasis or of the later complications of the disease.

Tartar emetic remains the best drug for treatment, despite some unpleasant effects experienced by the patient during the period of administration. The course should amount to a total of 30 gr. and it must be intensive lest the parasites acquire a resistance to antimony. There are also some more recent preparations such as stibophenium antihomaline and foudain. These are administered intramuscularly; this is of great value in the treatment of the school children of the Delta. These preparations obviously have advantages when large numbers of troops are treated but they are not considered to be so certainly curative as is antimony sodium tartrate. Antimony first sterilizes the generative apparatus of the female worms and ultimately destroys them. It is not known just how certain is the effect upon those ova which have been deposited before treatment was begun.

It will be agreed that we must keep our eyes open for occasional cases of this disease. Not only officers but men of all three Services have been in the countries where this disease is endemic.

JOHN A. LORR, M.D.

Combes, F. C., Canizares, O. and Landy, S.: Lymphogranuloma Venereum. *Am J Syph.*, 1945 29 611

The problem of diagnosis of so-called latent forms of lymphogranuloma venereum has never been

solved and this inability to determine the presence or absence, or the degree of activity of the disease is a serious handicap. Patients considered cured discharged, and allowed to resume their normal activities frequently have a residual, small hard mass in the inguinal region which has been interpreted as a fibrotic reaction and a sequela of the reparative process but there is no proof at present that these patients are definitely cured and that they do not harbor dormant but viable virus in these nodes. The same problem exists in patients with aogenitrectal involvement. A test capable of detecting evidence of activity during these "latent" periods should be invaluable. The Frei reaction persists after convalescence for an indefinite time, and is not so indication of the degree of activity. The complement fixation test of Grace Shaffer and Rake is not yet standardized and perfected.

There are definite changes in the blood serum proteins of patients with lymphogranuloma venereum, chief of which is a hyperglobulinemia. The formol gel test is predicated upon the presence of an increase in seroglobulins, and is not specific for any disease. A rapidly positive formol-gel test indicates a high seroglobulin. The authors made formol-gel tests and albumin-globulin ratio determinations on 42 cases of lymphogranuloma venereum and formol-gel tests on 307 controls. Of the 42 known cases of lymphogranuloma venereum, 38 had positive formol-gel reactions after the disease had been present for three weeks and these were consistently positive after the disease had been present for several months or years especially in active anorectal cases. Of the 307 controls only 6 gave positive reactions. The authors conclude that the formol-gel test is a simple reliable bedside procedure of value to determine the presence of hyperglobulinemia in lymphogranuloma venereum. There was a tendency toward a return to normal after a clinical cure in 85 per cent of the cases. Hyperglobulinemia is of some value in determining the degree of activity of lymphogranuloma venereum and formol-gel reactions and albumin globulin ratios should be determined in all patients as an aid in treatment and for indication of biological cure.

DAVID ROSENBLUM, M.D.

Magnuson, H. J., and Eagle, H.: The Retardation and Suppression of Experimental Early Syphilis by Small Doses of Penicillin Comparable to Those Used in the Treatment of Gonorrhea. *Am J Syph.* 1945 29 587

The widespread use of penicillin in the treatment of gonorrhea has raised several problems with respect to the effect of such therapy on concomitantly acquired syphilis. Since the doses of penicillin usually employed (100,000 to 200,000 units) are sufficient to cause the disappearance of treponema pallidum from primary lesions which were previously dark field positive and since these doses are subcurative for established syphilis in man, it is conceivable that such therapy given during the incubation period of syphilis might (a) prolong the incubation period

(b) suppress the symptoms and result in an asymptomatic infection, or (c) actually abort the syphilis. A number of cases have been reported in which penicillin therapy for gonorrhea has rendered the diagnosis of syphilis difficult either by making a pre-existing but unrecognized primary lesion darkfield negative or by delaying the appearance of symptomatic or serologic evidence of the disease.

The authors demonstrated that, in rabbits small doses of penicillin have definite suppressive effects on the development of the lesions of early syphilis. The smaller the spirochetal inoculum the more pronounced is the suppressive action of penicillin and the suppressive action is maximal when the penicillin is given before the seventh day of the illness. When penicillin fails to prevent the appearance of the primary lesion, it regularly causes a significant prolongation of the incubation period probably because most of the organisms have been killed by the penicillin and the few residual organisms take more time to develop a primary lesion. In some cases the primary lesion and the infection were aborted. In general, the smaller the inoculum and the earlier treatment was begun the greater was the proportion of inoculated sites at which lesions failed to develop.

Clinically doses of penicillin comparable to those used in the treatment of gonorrhea may materially modify the course of syphilis simultaneously acquired in many of the cases the incubation period is merely prolonged and the patient may no longer be under medical supervision at the time of development of the lesion. Patients treated for gonorrhea with penicillin should be followed up both clinically and serologically for a minimum period of 4 months after exposure in order to minimize the possibility of delayed primary lesions or clinically asymptomatic syphilitic infections, and the patients should be specifically advised of this danger.

DAVID ROSENBLUM, M.D.

Joishi, L. B.: Urinary Calculi. *Ind J Surg* 1945 7: 69

The author's article may be summarized as follows:

1. The uriniferous tubule probably acts on the principle of a flush.

2. All deposits in the kidney which are insoluble pigments, and casts could be seeds of urinary stones.

3. Sodium chlorides and sulfates have the property of preventing the formation of urinary stones.

4. The tertiary rock map of the world in association with the big rivers resembles the map of distribution of urinary stones.

5. The scarcity or abundance of water has no effect on the incidence of urinary stones.

6. The temporary hardness of water is one of the most important causes of urinary stones.

7. The envelope shaped crystals seen in oxaluria are composed of potassium oxalate and not of calcium oxalate.

8. In cases of phosphaturia, gastric analysis often reveals achlorhydria or hypochlorhydria.

9. Calcium sulfate is a fairly common constituent of urinary stones.

10. The age incidence of urinary stones probably depends on the general standard of health and care of children.

11. Town people acquire more urinary stones (than the rural population) if the water is not chlorinated or filtered.

12. Whales sailors of old days, and long term jail inmates have no urinary stones.

JOHN A. LOEY, M.D.

Wilson, J. G., Benjamin, J. A. and Leshy, A. D.: Study of Experimental Urinary Calculi: Methods for Producing and Preventing Calcium Formation in the Bladder and Urethra of Albino Rats. *J Urol* 1945, 54: 393.

Newborn albino rats were injected thrice weekly with 0.1 mgm. of estradiol dipropionate for a period of from 3 to 4 weeks so that the total dosage was either 0.6 or 1.2 mgm. Seventy-eight injected animals were fed on a commercially prepared stock ration which did not vary much from other such preparations, all of which are of a high mineral content. Thirty-four animals were fed on a low mineral diet which was of sufficient amount to be compatible with normal growth and reproduction. Beginning at 30 days of age periodic examinations by palpation of the bladder and the urethra, and by x ray were made to detect the presence of stone. Urinary infection was ascertained by culture and by the ability of the organisms to split urea. The urine pH was determined on each specimen.

Forty-five animals were fed on a high mineral diet until the presence of stones was ascertained, death ensued, or until 15 months of age was reached. In this group there were 39 male animals, 21 (52.6%) of which developed vesical or urethral calculi between the first and the fifteenth months, and during this period none of the females or control animals developed stones.

In order to determine the accuracy of x ray and palpation as a method of demonstrating urinary calculi 23 male and 12 female animals were fed high mineral diets after weaning and were sacrificed at intervals for autopsy. The results confirmed the opinion that the stones began to form sooner than they could be detected by means other than autopsy. The authors state that if all the males had been permitted to live to the age of 150 days, it may be estimated that at least 20 (47.6%) would have yielded stones at autopsy as contrasted with 29.5 per cent of known cases of lithiasis at this age in the previous group of male animals. Also 1 female in the autopsied series was found to have stones in the bladder. There was no difference in the incidence of stones in the group receiving 0.6 or 1.2 mgm. of estradiol dipropionate.

Cultures of bladder urine of injected males showed infection whether or not calculi had formed.

Specimens from 13 older males yielded *escherichia coli* in 10 and the remaining 3 showed a nonhemolytic streptococcus alpha hemolytic streptococcus and a mixed streptococcus fecalis and *escherichia coli*. No correlation existed between the infectious agent and the age at which the host formed calculi and the urine of animals having calculi was always more or less alkaline. Urinary infection always preceded calculus formation.

Seventeen of the 24 males with infection showed focal sites of infection in the bulbourethral gland and occasionally in the prostate seminal vesicles or bladder wall but rarely in the kidney. In the injected females 9 of the 20 had infected bladder urine, but it is of particular interest that at necropsy not a single instance of focal infection was found in the urinary tract. Focal infections were observed in the atrophic uteri and oviducts in 8 of 28 cases but were not always associated with infection in the urine.

All stone bearing males revealed some urinary tract abnormality with a variable resultant stasis. The most persistent finding was obstruction between the bladder and urethral sinus which seemed occasioned by the common finding of an abscessed bulbourethral gland. Then too the sectioned urethra at this point of several young estrogen injected rats revealed great numbers of desquamated cornified cells, often in the form of large plaques suspended in the lumen. No urinary obstruction was found in the female animals except in the one which developed a stone.

Nineteen males and 15 females were injected during the first 2 weeks of life. They were fed a low mineral diet and sacrificed after a period of 180 days. Two males in this group revealed calculi the other animals were free of stones. The stone incidence in this group was reduced from 82.8 per cent to 10.5 per cent by feeding a group of injected animals on a low mineral diet.

The authors concluded from their experimental work, that (1) infection preceded stone formation (2) alkaluria was characteristic of stone forming animals (3) neither the type of organism nor its urea splitting potentialities was related to the urine pH or calculus formation (4) urinary stasis accompanied calculus formation but was not necessarily responsible, and (5) lithiasis so produced could be materially reduced by a diminished mineral diet.

ROBERT LICH, JR., M.D.

Benjamin J. A. Wilson J. G., and Leahy A. D.: Study of Experimental Urinary Calculi; Quantitative Microchemical Spectrographic, and Citric Acid Analyses of Albino Rat Calculi, with a Preliminary Apatite Report. *J. Urol. Balt.*, 1945 54 516.

The stones analyzed in this paper were produced experimentally in rats by feeding them on a high mineral diet and subjecting them simultaneously to injections of estradiol dipropionate. The calculi varied in size from 1 to 6 mm.

Ninety per cent of the stones showed a composition of magnesium ammonia, phosphate, and moisture. Calcium was found in small amounts as was citrate and carbonate in only minute amounts. These results were confirmed by spectrographic analysis. It was found that carbonate-apatite was a common constituent of the stones studied.

The principal chemical constituents in this series of calculi were reasonably constant, irrespective of the size, shape, or site of origin. Bladder calculi as compared to urethral calculi were white in color rather than brown but in both, magnesium ammonium phosphate hexahydrate was the principal compound, though the urethral calculi contained calcium and more phosphate.

Spectrographic studies confirmed the findings, and occasionally revealed small amounts of sodium, iron, aluminum, and silicon. ROBERT LICH, JR., M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Jönsson, G.: Has Acute Hematogenous Osteomyelitis Become Less Common and Less Severe? *Acta chir scand* 1945 93 533.

The author has gone through the material of 30 years (1913-1941) of hematogenous osteomyelitis seen at the Surgical Clinic in Lund. This followed a suggestion made during the last decade that acute hematogenous osteomyelitis has changed in character in that it has become less severe with the years and at the same time a disease that occurs less and less frequently.

The material consists of 135 cases. Its distribution regarding sex and age corresponds to the figures usually given. If the cases are divided into 5 year periods one finds that the smallest number has been treated during the last period during which no death occurred. The study reveals that a smaller number of complications have occurred during the last 5 year period as compared with earlier ones. The duration of treatment has been considerably shorter during later years. During recent years the patient's condition on admittance to the clinic has been much better than formerly. In nearly all of the cases the treatment has been operative. Serum or chemotherapy has not been employed in any of the cases.

The Lund material gives one the very definite impression that the disease has had a considerably more benign course during later years than previously, with fewer deaths during the septic initial stage, fewer complications during the later stages, and a more rapid course of healing.

Buchman, J., and Blair, J. E.: Penicillin in the Treatment of Chronic Osteomyelitis. A Preliminary Report. *Arch Surg* 1945 5 8.

The authors conducted a clinical and bacteriologic study of the results of treatment of chronic osteomyelitis with penicillin, with and without surgical intervention. There were 68 lesions in 47 patients.

Some of the conclusions drawn are tentative because of an insufficient period of follow-up but others are sufficiently clear and certain.

The use of penicillin alone, whether given by local application or intramuscular injection, is totally ineffective in chronic osteomyelitis. If after preoperative and postoperative administration of penicillin and thorough saucerization the resultant wound is allowed to heal by granulation the results are not materially influenced by the addition of penicillin to the treatment. The same type of treatment and delayed primary closure (rather than allowing healing by granulation) constitute a considerable improvement over previous methods. The treatment of chronic osteomyelitis by preoperative and post-

operative administration of penicillin, thorough saucerization of the focus of infection and primary closure of the resultant wound gave extraordinarily good results in 23 of 27 patients, but the authors state that the postoperative period of observation was insufficient.

Of the tuberculous lesions of the bones and joints secondarily infected with *coagulase positive staphylococcus aureus*, treated by the preoperative and postoperative administration of penicillin, and subjected to thorough saucerization and primary closure a limited number presented primary healing over a short period of observation.

A distinct advantage of primary closure is the reduction in the incidence of secondary infection which so frequently (80%) complicates delayed closure. *Staphylococci* persisting in wounds healing by granulation or delayed closure develop increasing resistance to penicillin.

DANIEL H. LEVINTHAL, M.D.

Altmeier, W. A., and Reineke, H. G.: Roentgenographic Interpretation of Acute Hematogenous Osteomyelitis Treated with Penicillin. *Am J Roentg* 1945 54 437.

The introduction of penicillin has completely altered the management of acute hematogenous osteomyelitis. The rapid control of the general and local infection makes an emergency surgical decompression of the area of the bone involved unnecessary except in the fulminating cases. Operative intervention as a rule, is limited to incisions and drainage of abscesses of the soft tissues and to removal of sequestra. Because of this milder course the bone changes which follow show a different appearance from that which is known to characterize the subsequent stage of acute hematogenous osteomyelitis and therefore roentgen interpretation merits our attention.

During the past 27 months the authors observed 52 cases of acute hematogenous osteomyelitis treated with penicillin. In 44 of these the osteomyelitis was localized in the long bones, in 4 to the flat pelvic bones, and in the remainder to both. The etiologic agent was represented by the hemolytic *staphylococcus aureus* in 42 cases, the nonhemolytic *staphylococcus albus* in 3, the hemolytic *streptococcus* in 1, and the *pneumococcus* III in 1 and it remained undetermined in 4 cases.

All of the cases were treated with penicillin, although in 28 limited amount of sulfonamides were given prior to the penicillin. The early cases received less than 800,000 units of penicillin, but eventually a total of 1,500,000 units given intravenously or intramuscularly at the rate of from 15,000 to 25,000 units every 3 hours proved the most desirable dosage. In some cases it was administered by intravenous drip at the rate of from

15 to 30 drops per minute in the form of 2 000 c.c. of physiological saline solution containing 30 000 to 80 000 units of penicillin. The dose was reduced when it became apparent that the infection was controlled.

The results were remarkable. All patients recovered except 1 so that the mortality was only 19 per cent. The period of morbidity likewise was strikingly reduced.

Clinically the cases were divided into four groups.

Group 1 The correct diagnosis was made within the first 2 or 3 days and adequate treatment started immediately. The results were truly excellent.

Group 2 The diagnosis and treatment were moderately delayed. Here the infection was brought under control in 2, 3, or more days and local soft tissue abscesses developed more frequently.

Group 3 The diagnosis and treatment were delayed for from 7 to 10 or more days when the infection was unusually severe, local destruction of bone became very great, and soft tissue abscess formation and sequestration occurred in most cases. In this group the infection was arrested with more difficulty and rather prolonged treatments were necessary. Small abscesses were treated by aspiration, large ones by incision and drainage and the sequestra were removed.

Group 4 The osteomyelitis was so fulminating that surgical intervention still constituted an emergency measure. In such instances penicillin at the rate of 15 000 units every 1 to 3 hours was given preoperatively and postoperatively.

The roentgen changes in the various groups were interpreted as follows:

In group 1 the bone alterations were minimal consisting of areas of localized periosteal reaction, small areas of patchy decalcification of the underlying cortex, little or no evidence of sequestration and ultimate reconstitution of the bone. In 3 cases the roentgen findings were entirely negative.

In group 2 the changes likewise were minimal at the beginning of the treatment, but after a week or so periosteal reaction and patchy demineralization of the underlying cortex became evident. These increased in extent and degree, becoming most marked in from 1 to 3 months after the onset of the infection. Then, recalcification followed with rapid return to normal. Sequestration occurred only occasionally. In group 3 there was extensive bone destruction at the start of the penicillin therapy. This increased on subsequent examinations. Small sequestra were absorbed spontaneously and larger ones acted as autogenous grafts. Rarely was the sequestrum discharged. Recovery followed eventually.

In group 4 the bone destruction was very extensive due to the severity of the infection.

The authors include detailed clinical histories of 6 typical cases and use serial roentgenograms to illustrate the course of the disease under the influence of the penicillin therapy and the good results obtained.

T. LEUCUTA, M.D.

Lewis R. W.: Differential Diagnosis of Tuberculosis in Joints of the Extremities. *Am J Roentg* 1945 54 320.

In 1924 Phemister described the principal criteria of differential diagnosis between tuberculous and nontuberculous suppurative arthritis. These criteria still stand although they are not as widely employed as their importance warrants. Therefore, the author wishes to restate them and add some new ones of his own.

According to Phemister in pyogenic arthritis there is early narrowing or disappearance of the joint space because of the fact that the articular cartilage is killed and broken down first at the points of contact and pressure of the opposing articular surfaces. For the same reason the earliest bone destruction occurs in the opposing or weight bearing portions of the articular surfaces. In contrast to this in tuberculous arthritis the joint space is preserved for months or years since the earliest destruction is peripheral along the surfaces where tuberculous granulations can grow. Likewise the earliest bone destruction is not on the contiguous opposing bony surfaces but about the margin of the weight bearing surfaces.

To these points the author adds (1) in acute pyogenic arthritis osteoporosis about the joint is rapid and marked whereas in tuberculous it is usually lacking; (2) acute pyogenic joints show a distinct tendency toward repair and ankylosis features which are customarily absent in tuberculous; and (3) in tuberculosis the adjacent muscles often are markedly atrophic which is not the case in acute pyogenic infections.

Unfortunately however the picture is not always so clear. There are many variables due to difference in virulence of the invading organisms and reaction in the host. Another confusing factor is the apparent difference in the roentgen manifestations of certain joints as for example the hip joint, in which the criteria of Phemister are seldom observed and therefore the differential diagnosis must be more circumspect. Still another difficulty is created by the rather infrequent but entirely different form of tuberculous the so-called *caries sicca*.

The differential diagnosis of tuberculous of joints from other diseases than acute pyogenic infection as a rule, is quite easy although lymphatic leucemia and probably some other conditions may simulate tuberculous arthritis.

Several illustrative cases are presented to prove the various points.

T. LEUCUTA, M.D.

Simon H. E.: Muscle Hernia, with Report of 6 Additional Cases in the Arm and Leg. *Mil. Surgeon* 1945 97 369.

Muscle hernia or protrusion of muscle tissue through a defect in the overlying fascia is rarely recognized in civilian life. In military service, it is frequently observed and often symptomatic. The author presents 6 case reports to add to the 163 cases of muscle hernia described in the literature.

Three of the patients developed the hernia in the lower extremities and 3 in the upper. The condition occurs almost invariably in the third and fourth decades and is practically limited to males. Three types are recognized.

The congenital type. No case has been found in the literature which was primarily of congenital origin.

The traumatic type (a) Direct trauma as laceration, contusion or puncture wound (b) Indirect due to a single powerful muscle action.

The idiopathic or spontaneous type. Due to increase in muscular development and activity.

The anterior tibial muscle is the one usually involved although hernia may appear anywhere. It appears as a circumscribed semitransparent swelling which varies in size according to the position of the part involved and the state of contraction of the underlying muscle. Typically the swelling increases in size with muscle relaxation and is reduced by pressure which reveals a circumscribed defect palpable in the fascia. Aching pain or local tenderness may be present as well as muscle cramping and increased fatigability.

Hernias due to direct trauma appear immediately or several months after the resumption of muscle activity. They may reach a diameter of 6 cm. or more. Pain and discomfort are more pronounced.

Those due to indirect trauma appear abruptly after the accident.

The idiopathic type is usually small and not infrequently multiple and bilateral and occurs almost exclusively in the legs. It may be mistaken for localized varicosities, arteriovenous aneurysms, lipomas, myomas, or cysts.

Treatment is indicated when the defects are large and deforming, or produce symptoms that are interfering with normal activities.

Temporary symptomatic relief may be attained by elastic pressure bandages. For permanent cure surgery is usually necessary. This consists of careful exposure of the fascia defect and closure by overlapping and suture of a fascial transplant with lapping and suture of an interlacing strip.

When the defect is large, a fascial transplant may be used either as a patch or an interlacing strip—the patch is preferable. Pressure immobilization for 3 weeks is maintained for 3 weeks. Elastic bandages or cast is maintained for 3 weeks postoperatively after which activity is gradually resumed.

VANAN C. TUNNEY, M.D.

Wyatt, H., McWhirter, R., and Johnson, H.: A Symposium on Ankylosing Spondylitis. *Brit. J. Radiol.* 1945 18 306.

In this symposium Wyatt of the Ministry of Pensions gives an account of the results of the treatment of pensioners suffering from ankylosing spondylitis by deep x ray therapy and massage. After the last war the disease was observed rarely but in this war it has become much more common. The author supervised the treatment of about 100 cases. The present scheme is to arrange x-ray treatment on 5 consecutive days in a week, the first course gen-

erally lasting 3 weeks. This results in much relief of pain although stiffness persists. The treatment is repeated at intervals of from 2 to 3 months. In the interim suitable exercises are given in a Ministry Clinic, sometimes preceded by some form of heat, such as radiant heat or diathermy. The exercises are given by masseuses. In the main, the lies in relaxation of spasm and posture and increased mobility of the spine and thorax. Breathing exercises are important and are done in various positions. After all treatment is completed the men are encouraged to return to work. The author rarely hears from such men, unless it is to report that they are proceeding satisfactorily.

McWhirter of the Edinburgh Royal Infirmary gives a clinical discussion of the subject. To avoid confusion he assumes that ankylosing spondylitis is synonymous with Marie-Strumpel type of spondylitis ankylopoietica.

It is important that the disease be recognized early since, unfortunately little or nothing can be done in the advanced stages.

The author's experience covers 165 cases, of which 100 were in males. As a rule, the onset of the condition occurred during the third decade of life.

The earliest symptoms are fleeting pains in the back and hips followed by more constant pains localized in the lumbar region. Then the back becomes stiff and there is some deterioration of the patient's general health. Chest expansion becomes restricted and the sedimentation rate is raised. X ray examination shows blurring and irregular destruction of the sacroiliac joints, with sclerosis of the bone adjacent to the joints. The spine at this stage shows little or no change.

As the disease progresses the posterior articular surfaces of the spine become narrowed and the margins of the vertebral bodies become sharp. Still later the anterior and lateral column ligaments become ossified and eventually the entire spine assumes a bamboo appearance. Less well recognized changes are irregularities of the ischial tuberosities, ilium, symphysis pubis, and of the sternum. Some of the joints of the extremities may also become involved.

The etiology remains unknown.

The treatment consists of a combination of deep x ray therapy and various orthopedic measures. The x ray therapy is localized to the sacroiliac joints and the whole length of the spine. The factors are 250 kv., 1 mm. of steel, and 500 roentgens of skin dose on all fields given over a period of two weeks. This produces a reaction not exceeding dry dermatitis.

According to the x-ray findings, patients are classified into (a) early, (b) moderately advanced, and (c) advanced cases. Patients in the first two classes are put to bed with fracture boards under the mattress for several weeks. Deep breathing exercises are started first, then other exercises are carried out with the patient on his face until the lumbar

stiffness is overcome. After the patients are up a light brace is fitted in group *a* and a light plaster jacket in group *b* which may be worn from 6 to 12 months or longer.

The results are encouraging. In group *a* the patients have remained well for as long as 7 years. In group *b* relief of pain and general improvement are often obtained for varying periods. Even in group *c* some relief of pain and unless the spine is completely ankylosed a partial correction of the deformity is possible.

Johnson of the Charterhouse Rheumatism Clinic in his part of the symposium pays special attention to the prognosis of spondylitis in relation to treatment. He takes exception to the very gloomy view as expressed in Volume 2 of the British Encyclopedia of Medical Practice (1936). The books of the Charterhouse Rheumatism Clinic contain reference to some 500 spondylitis patients. A review of these records reveals an entirely different aspect.

The disease is almost certainly an infection possibly due to a form of tubercle, although some regard it as a disease of the endocrine system. In many instances breakdown of the natural resistance seems to be determined by physical overstrain or by an accident. In the untreated case the prognosis depends on this breaking down of the natural resistance.

Some years before his death Scott introduced the wide field method at this institution for the x-ray treatment of ankylosing spondylitis. The principle behind this method was to stimulate the natural resistance. The results were so satisfactory that the method is being continued. An average dose of 50 roentgens twice a week is given but in some cases it is reduced to 10 roentgens to avoid all possible unpleasant reaction. Hemoglobin estimation and special sedimentation tests are often necessary guides. The total dosage in 1 year is not allowed to exceed 1,500 roentgens.

If x-ray treatment cannot be given, stock vaccines of streptococci and staphylococci given weekly are often a good substitute. Other forms of stimulus, such as cold or even ultraviolet ray baths, may be of value. Potential foci of infection should be removed.

Under such care the prognosis as regards the continued capacity to earn a living is good. Nearly all patients of the Clinic are able to hold down ordinary jobs. Neither are they dissuaded from marriage. There is no proof that the disease is hereditary.

T. LECUIT, M.D.

Hooker D. H.: Brachymetopody. *Bull Johns Hopkins Hosp.*, 1945 77: 399.

Brachymetopody is a condition in which certain digits of the hand or foot are shorter than normal. It is caused by abnormally short metacarpals or metatarsals, respectively. Three cases are presented in which there were short fourth toes.

The chief complaints were metatarsalgia, callosities over the metatarsal heads and relaxed longitudinal arches. The condition apparently was present at birth. All of these patients began having



Fig. 1. Shortening of otherwise normal fourth metatarsal bones, each metatarsal being about 1.5 cm. shorter than the adjacent third metatarsal.

trouble with their feet after basic training in the Army.

A hereditary factor was established in every one of these cases. The treatment consisted of arch supports, metatarsal pads, weight reduction and limited physical activity.

A congenital origin of brachymetopody is suggested by the author.
GEORGE I. REINE, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Knight, M. P., and Wood G. O.: Surgical Obliteration of Bone Cavities following Traumatic Osteomyelitis. *J. Bone Surg.*, 1945 27: 547.

High velocity war missiles have not only contributed many cases of osteomyelitis of the long bones but have furnished the orthopedic surgeon with many massive soft tissue and bone defects. Since skin and muscle defects over the long bones unequivocally interfere with bony repair the authors have devised a new approach for the expeditious obliteration of such cavities. It is apparent that if left alone, these defects would prolong rehabilitation and increase morbidity. To expect bone growth to ensue in the presence of infection, granulation, or even scar tissue, is indeed a bizarre expectation. Furthermore, bone does not show any demonstrable evidence of regeneration beneath adherent split thickness grafts as the cavities remain essentially the same size for an indefinite period of time. Previous efforts to obliterate septic cavities by anti-septic paste fat muscles and pedicle grafts have also proved unsuccessful.

The authors present a small series of 33 cases which were operated upon in three stages: (1) thorough sequestrectomy and excision of scar, (2) early split skin grafting and (3) bone grafting followed by immediate application of a full thickness pedicled graft.

The first stage is that of sequestrectomy and preparation of the cavity. All extracapsular soft tissue must be excised. Exposed bone or cartilage. If the defect is near a joint must be saucerized in its entirety. The wound is then packed with vaseline gauze and the limb is encased in a cast. At the end of 5 days the wound is inspected and if an exuberant granulation is noted on the bony cavity a split grafting operation is done to convert the compound wound into a closed one.

The second stage comprises the application of a split thickness skin graft. The recipient area is curetted of any nonviable or granulation tissue, and a split thickness graft from 0.10 to 0.16 of an inch is obtained and placed over the defect. A pressure dressing (Koch's) is applied on the wound. Immobilization is effected by a splint or cast. Chemotherapy consisting of penicillin or sulfonamides is administered for 3 days. Under this regime from 80 to 95 per cent skin take has been observed.

The third stage consists of obliteration of the bone cavity with autogenous bone chips. The principal factors of this stage are:

1. Planning of a suitable full thickness covering for the defect.
2. Complete excision of the split thickness covering from the depth of the saucerized bone defect.
3. Procurement of sufficient bone chips from the iliac crest or other suitable sites to fill the cavity completely.
4. Covering of the chip filled cavity with skin and subcutaneous tissue without skin tension and placing the suture line on sound bone.

Osteogenic consolidation of the defect can be further enhanced by curetting the cavity and opening both ends of the medullary canal. A pressure dressing of machinist's waste is again applied. Sutures are removed in 6 days. Chemotherapy is continued for from 3 to 5 days, and immobilization is maintained until bony union is obtained.

Accompanying the article are many excellent photographs of the technique and numerous roentgenograms of the bony defects involving the tibia and femur.

The complications encountered in the 33 cases were hematoma in 2 tibias, suppuration in 1 tibia, and a draining sinus adjacent to the operative site in a femur.

SAMUEL L. GOVERMAN, M.D.

GILLIE, L. I. Nearthrodis of Humerus Shaft for Amputation at the Elbow. *Brit. M. J.* 1945 2: 686.

The author describes a new operation for making a joint in the shaft of the humerus for cases of amputation at or near the elbow joint. According to this article it is no longer necessary to amputate an arm at the orthodox site of election, i.e. 7 or 8 inches below the tip of the acromion. It is to be remembered that the forearm resected at, above, or below the elbow joint can now be fitted with a useful prosthesis.

As its purpose the operation is designed to accomplish two distinct functions (1) to conserve the

muscular power of the flexors and extensors of the forearm and to harness that function and (2) to make a new joint in the shaft of the humerus at least 4 in. below the shoulder which should possess the property of complete extension and a varying degree of flexion.

The author has performed 24 such operations.

The first 8 of these necessitated a second intervention for removal of increasing ankylosis of the joint in order that bony union of the new joint be prevented. The technique was altered as follows:

1. A posterior muscle splitting incision from 3 to 3 3/4 inches long was used.
2. From 1 1/4 to 2 inches of the humeral shaft were removed with a gigli saw.
3. The ends of the bones were bevelled at an angle of 45 degrees in front to permit the maximum degree of flexion.
4. The medullary cavity of the bones was curetted and packed with bone wax.
5. The bone ends were fulgurated and sulfanilamide implanted in them. This step is considered important by the author as it vitates osteogenesis.

The postoperative management consists of the application of a straight plaster of Paris cast for 3 weeks, active and passive motion of the new forearm, and the application of a figure 8 crepe bandage.

In addition to several illustrations, the article contains 5 detailed case reports depicting the technical periparties encountered in the original operation and their solutions.

The results in 10 cases show uniform function of flexion and ability of the patient to touch his face and back of the neck without pain. Six of the 21 patients have acquired varying degrees of active flexion and the condition is still improving. Functional results in the first 8 cases (operated twice) were not noted.

SAMUEL L. GOVERMAN, M.D.

FRACTURES AND DISLOCATIONS

ELLA, J. S. Wounds in the Region of the Hip Joint. *Lancet*, Lond. 1945 249: 490.

The unsatisfactory results in a group of 44 wounds of the hip-joint and high femoral fractures treated in the base hospital attended by the author prompted a review of the methods used and led to the suggestion of improvements.

In 1914 to 1918 the mortality in this group was 60 per cent, accounted for largely by visceral injuries and a stiff hip with shortening and often persistent draining sinuses was accepted as the usual result. Recent Russian writing advocates radical surgery with early resection of the joint or disarticulation at the hip, to control toxemia.

The patients were received from 1 to 4 weeks after injury and had either obvious wounds of the hip joint or fractures in the area of the neck or trochanter with doubtful penetration of the hip joint. Twenty two patients had been or still were toxic

when received. All had been explored and foreign fragments had been removed including many bone fragments. Plaster spicas or Thomas splints were used for transportation and usually changed en route at the receiving hospital where some wounds were re-explored. Systemic administration of sulphonamides and penicillin was done routinely. The best hospital employed skeletal traction in Thomas splints and plaster fixation about equally. Sequestrectomies and 5 major drainage operations of the Girdlestone type were done.

Ankylosis of the hip occurred in 13 of the 16 cases in which the hip joint became septic. In 16 patients the wounds were unhealed at 6 months. Six patients had 1 inch or more of shortening.

Slow healing is due to inadequate primary drainage which makes delayed primary suture impossible and later to failure to recognize early the need for sequestrectomy or drainage of hidden abscesses. The use of penicillin masks the presence of undrained pockets and thus must be remembered in appraising the situation.

The shattered femoral head must be removed early to facilitate healing.

Shortening is inevitable in head and neck fractures but traction rather than plaster immobilization overcomes the tendency toward bowing and shortening in trochanteric fractures. Early knee motion is of great importance and need be delayed only when the desire to encourage hip fusion requires plaster immobilization rather than traction in a Thomas splint.

No living limb was lost in this series but in retrospect, morbidity might have been reduced by the knowledge gained and summarized here. Roentgenography before primary treatment is desirable to determine the status of the fracture, especially as to whether the femoral head is involved. Bone fragments should not be removed freely unless they are all or part of the femoral head. Rectal examination is essential to help establish the extent of possible intrapelvic injuries. A minimum of skin should be excised—no skin should be sutured—and a plaster spica should be used for transport. Systemic chemotherapy of course is used early and a "booster" dose should be given again before each change of cast or other manipulation to inhibit flare up of the infection.

Adequate later treatment necessitates removal of the cast and careful estimation of the patient's general condition with reapplication of the plaster spica only when ankylosis of the hip is desired. Constant vigilance for abscess formation or the presence of foreign bodies or sequestra, with prompt surgery will prevent persistent sinus drainage and lessen the morbidity. Early appreciation of the cases requiring radical treatment for deep seated infection, and prompt surgery of the Girdlestone type will save life and reduce morbidity. In the author's experience the end result of this treatment has been satisfactory.

FRANCIS C. BREWSTER, M.D.

Godoy Moreira, F. E. Difficult Fractures of the Neck of the Femur Treated with the Stud Bolt Screw. Simplification of Technique. *J Bone Surg* 1945 27 595.

In July 1940 the writer reported a technique for treating ununited fractures or otherwise difficult cases of fracture of the neck of the femur with the stud bolt screw. Since then the technique has been simplified. A hand drill has been substituted for the motor drill and the hard cortex is perforated by a hand driven burr preliminary to the insertion of the stud-bolt screw.

Eighty patients have been treated by this technique with excellent results and 8 case reports are presented illustrating that good union and function may be obtained. One patient, a 65 year old female was operated on 2 days following fracture of the femur. Four months later she had perfect union with normal function. The remaining 7 patients sustained fractures from 3 to 18 months before operation, the youngest being 40 and the oldest 70 years old. Of the 7, 6 obtained good union and perfect function while in 1 a 70 year old male, nonunion persisted but the patient was able to walk 3 miles easily. This good result is attributed to achieving solid osteosynthesis by means of the screw. In 2 instances osteotomy was performed at the same operation as an aid to union.

A short plaster spica is applied to the knee 20 days after operation and the patient is permitted to walk. The spica is removed 40 days afterward.

RUDOLPH S. REICHER, M.D.

ORTHOPEDICS IN GENERAL

Howard J. E. Parson W., and Bigham, R. S., Jr.: Studies on Patients Convalescent from Fracture. The Urinary Excretion of Calcium and Phosphorus. *Bull Johns Hopkins Hosp.*, 1945 77 391.

The calcium and phosphorus metabolism with special reference to Ca⁺⁺ concentration in the urine was studied in a group of 17 patients. Thirteen patients were convalescing from femoral and tibial fractures and 4 were studied before and after femoral osteotomy for slipped epiphysis.

This study was made in an attempt to explain two frequently observed conditions in recumbent orthopedic patients: (1) nephrolithiasis and (2) a lack of lime salts in the bones of limbs immobilized for long periods of time.

A steady rise in the calcium output in the urine was noted. It reached its maximum approximately 1 month after injury. The peak of excretion of calcium was maintained for an indefinite period. It usually began to fall when the immobilization was discontinued.

A similar pattern of urinary calcium excretion was observed in patients who had had a femoral osteotomy. The peak of calcium excretion, however, was reached much earlier. In patients who had suffered a fracture a rapid breakdown of protein occurred

with the excretion of large amounts of nitrogen. The maximum amount of urinary excretion of nitrogen was reached in from 5 to 7 days. It subsided in from 25 to 40 days.

Maximal excretion of calcium in the urine occurred in every instance at a time when the urinary output of nitrogen had returned to normal. The same reciprocal relationship between maximal diuresis of calcium and nitrogen had been observed in patients subjected to femoral osteotomy.

The type of injury (simple or compound fracture) and the patient's age, height, and weight or bony structure (heavy or light bony frame) had no bearing on the urinary output of calcium. The increase or decrease of water intake had no influence on the amount of calcium output in the urine. Alkalinization, sulfadiazine, or sulfathiazole did not change the level of the calcium excretion.

Large shifts in dietary calcium affected the urinary output of calcium very little. An increased or diminished intake of calcium in the form of calcium lactate had a somewhat greater influence upon the calcium diuresis than the intake of calcium in the form of milk.

Vitamin D₂ (calciferol) in varied doses, with or without an increased intake of calcium, did not significantly change the calcium excretion in the urine.

The rise and fall of intake of inorganic phosphorus showed similar changes in the urinary output of phosphorus.

The blood constituents of the patients showed no significant changes in the hemoglobin, red blood count, blood volume, calcium and phosphorus levels, and alkaline phosphatase concentration.

The theory that a decreased blood supply causes increased bone density and that hyperemia of the part results in skeletal rarefaction is challenged by the fact that reduction of the blood supply causes atrophy of the bone supplied. Unilateral lumbar sympathectomy in children caused the leg on the same side to improve its growth in most instances. This influence on the growth of the leg is exercised by the control of its blood supply. There is experimental evidence that venous obstruction accelerated fracture healing by speeding the formation of callus.

GEORGE I. RANE, M.D.

Balboni, V. G., Shapiro, I. M., and Kydd, D. M.: The Penetration of Penicillin into Joint Fluid following Intramuscular Administration. *Am. J. M. Sc.* 1945 50 588.

Seven patients with hydrarthrosis affecting one or more joints were studied. 5 had typical rheumatoid arthritis and 2 an atypical disease which was probably also rheumatoid arthritis. In only 1 case was the joint severely inflamed. Four of these patients received 25,000 units of penicillin in 25 ml. of normal saline solution administered intramuscularly every 3 hours and 3 received 40,000 units. In each instance samples of serum and joint fluid were obtained simultaneously $\frac{1}{4}$, 1, 2 and 3 hours after the

patient had received the eighth dose of penicillin. In 4 instances, however the samples were obtained 3 hours after the sixteenth dose, and in 1 instance, material was obtained 3 hours after the twenty-fourth dose. The concentrations of penicillin in both the blood sera and the joint fluids from these patients were determined by the cup assay method as modified by Cholden (*J. Biol. Chem.*, 1944 47 402).

In all cases penicillin was found to penetrate readily into the joint which resulted in that essentially equal amounts of the penicillin entered the joint fluid and blood serum 1 hour after its administration. In the case of the serum concentrations, it is true, they fell rapidly after 1 hour and at the end of 3 hours little or no penicillin was detectable in this body fluid, however in the joint fluids the concentration of penicillin decreased more slowly there being appreciable amounts of penicillin present 3 hours after its administration.

According to Rammelkamp and Keefer the effective concentration of penicillin in the blood is 0.3 Florey unit per milliliter and in the serum, 0.56 Florey unit. The joint fluid of the cases studied 1 hour after the administration of penicillin showed amounts of penicillin varying from 0.15 to 0.24 unit per milliliter and the determinations made 3 hours after administration in 6 of the 7 patients showed that it still contained from 0.05 to 0.17.

The authors conclude, therefore, that the amounts of penicillin which are antibacterial for the common pathogens invading joints are obtained in the synovial fluid by the intramuscular administration of penicillin in the doses discussed.

Penicillin did not tend to accumulate in the joint fluid.

JOHN W. BARNHART, M.D.

Bevans, M.: Changes in the Musculature of the Gastrointestinal Tract and in the Myocardium in Progressive Muscular Dystrophy. *Arch. Path., Chic.* 1945 40 225.

In this article 4 cases of progressive muscular dystrophy are reviewed, with special reference to lesions in the myocardium and in the smooth muscles of the gastrointestinal tract. Progressive muscular dystrophy has been regarded as an intrinsic disease of the muscles. More recently the disease has been classified as a disorder of the autonomic nervous system.

In the past many workers have found diffuse scarring and deposits of fat in the myocardium of patients afflicted with progressive muscular dystrophy. Many others denied having found any pathological changes in the myocardium or gastrointestinal tract in these cases. Other investigators described a cardiointestinal syndrome in patients with progressive muscular dystrophy which was accompanied by vomiting, generalized abdominal tenderness and pain, diarrhea, tachycardia, and signs of cardiac failure. One author found recent genitological changes in the esophagus similar to those described in scleroderma.

A detailed account of the history, physical findings, the course in the hospital, laboratory data and autopsy findings is given of the 4 patients with progressive muscular dystrophy. All of them died of pulmonary complications. The disease was usually discovered at the age of 4. It terminated with the death of the patient from 10 to 16 years later. The treatment of most of these patients consisted of the administration of acetylcholine, aminoacetic acid, vitamins B and C, and other purely supportive symptomatic measures.

All of these patients showed considerable wasting of all of the skeletal muscles on admission to the hospital. No muscular fibrillation was observed. Contracture of the muscles, especially of the plantar aponeurosis, gastrocnemius, and hamstrings was seen which placed the lower extremities in a froglike position. Abnormally increased mobility of the shoulder, hip and small joints of the hands was found. In most cases reflexes were absent. The electrocardiogram showed a right axis deviation and tachycardia in a few of the patients. The roentgenograms revealed moderate decalcification and considerable underdevelopment of the bones. In some instances the esophagus was slightly displaced by a dilated right auricle.

The laboratory data were normal except for a somewhat lowered basal metabolic rate in some cases.

On the autopsy table the muscles were found to be pale, thin, and streaked with yellowish fat tissue. In most cases the gastrocnemius, recti pectoral, iliopsoas and intercostal muscles were most seriously affected in the order mentioned. The heart was found to be hypertrophied and the endocardium was

thickened and streaked with fibrous bands. Some sections of the myocardium and papillary muscles were found to be completely replaced by scar tissue.

Microscopic examination of the skeletal muscles showed changes usually found in progressive muscular dystrophy. Large channel-like structures showing disintegrated muscle fibers in their lumens and capillaries in their walls were very significant. Such structures probably represent the persisting perimysium after the muscle fibers have disintegrated. Other findings were great variation of the size and shape of the fibers, vacuolation and clumping of the sarcoplasm and proliferation of the nuclei of the sarcolemma.

Sections of the myocardium and papillary muscles showed hyalinization, fibrosis, interstitial hemorrhages surrounded by mononuclear cells with phagocytosed red blood cells. The lower part of the esophagus showed considerable edema of the lamina propria, and the epithelium was irregularly desquamated. The small intestine showed similar changes in the muscular layers. In spite of the edema the width of the walls was greatly reduced and the muscular layers were atrophied. The rectal mucosa exhibited infiltration of red blood cells and areas of autolyzed mucosa. The muscularis mucosa layers were fragmented. The longitudinal and circular layers were atrophied and the muscular fibers widely separated.

No lesions of the smooth muscles of the vascular system or of any other organs were noted. With the exception of the presence of thymic tissue in 1 case no abnormalities of the endocrine glands were observed.

GEORGE L. REIS, M.D.

SURGERY OF THE BLOOD AND LYMPH SYSTEMS

BLOOD VESSELS

Gurdjian, E. S., and Walker, L. W.: Traumatic Vasospastic Disease. *J Am Med Ass* 945 129 668.

It has been known for some time that workers exposed to repeated percussion may develop circulatory disturbances in the hands. The condition is most frequently associated with the use of the pneumatic hammer or jack hammer. Pneumatic hammer disease has become synonymous with white fingers, dead fingers, traumatic vasospastic syndrome, vasospastic disease of the hands, and Raynaud's disease.

The first report on pneumatic hammer disease was made by Longa of Rome in 1911 while the first report on this condition in this country was made by Cottingham in 1917. Hamilton described the clinical findings in detail in 1918 after studying the problem arising out of a dispute between Indiana limestone cutters and their employers over the use of the pneumatic chisel.

The clinical pattern of traumatic vasospastic disease of the hands is almost stereotyped. After a few months to several years of exposure to the vibrations the patient notices attacks of blanching and numbness of the fingers. The pallor is much more pronounced than in Raynaud's syncope but it is not succeeded by the stage of extreme asphyxia so characteristic of the latter. It is not symmetrical even when in both hands.

The attacks may occur while the patient is working. Usually the blanching is most pronounced early in the morning particularly in cold weather. The attacks can be brought on by washing the hands in cold water or by going outdoors for a while in cold weather. They usually come on more frequently in the winter months, when exposure to cold is more apt to occur. Emotion does not appear to produce the attacks. The attacks do not result in wasting and death of the tissue. The workers are also subject to Raynaud's and Buerger's diseases and hemiparathesias not caused by the vibrations.

The present study is concerned with the clinical findings and the microscopic findings in the capillaries and arterioles of the fingers in 6 women war workers using a pneumatic riveter in airplane construction work in Detroit. The authors do not state the percentage of women affected in this occupational classification but to their knowledge this condition has not been described in women previously. Microscopic studies of the finger tips have not previously been reported. Serial sections of biopsies of the finger tips of 5 of the 6 patients showed no pathological changes except in two sections, revealing a red staining amorphous substance in the capillary.

The mechanism of the disorder is as yet unexplained. The possibilities mentioned are low tem-

perature of the surrounding air at the place of work, anemia of the hand from holding the air hammer too tightly and injury to the myoneural junctions of the arterioles in the fingers.

The clinical course of these patients has been characterized by attacks of benign vasospasm with little increase in severity over a period of 3½ years of study. The discontinuance of the use of the pneumatic hammer has not resulted in a single case of relief.

In the discussion de Takats stated that he believed that tools having a high vibration rate may produce a percussion neuritis. He mentioned Deny Brown's experiments with a single percussion of a nerve trunk which indicate that the damaged myelin escapes from its sheath into the endoneurial space and sets up an irritative internal demyelination of a mixed nerve which results in causalgia with its inco-ordination of circulation.

JOHN E. KIRK-UTRICE, M.D.

Elkin, D. C., and Kelly, R. P.: Arteriovenous Aneurysm. *Ann. Surg.* 1945, 33 329.

A near disaster from hemorrhage from the posterior tibial vessels in the course of the excision of an arteriovenous aneurysm prompted the authors to modify their approach to these vessels and remove the upper portion of the fibula, with resection of the head of that bone when it became necessary. The collateral anastomosis which develops as the result of arteriovenous communication together with dilatation of the vessels, including those which perforate the interosseous membrane demands direct visualization of these vessels and their careful ligation and division. Otherwise the retraction of vascular channels through the interosseous membrane may result in serious or even uncontrollable hemorrhage and necessitate a second incision along the front of the leg or the removal of the fibula in the presence of hemorrhage and at an inopportune time during the course of the operation. While this operation has been performed primarily as an approach to arteriovenous fistulas and aneurysms of the posterior tibial vessels it is of equal importance to realize that the same approach is necessary to reach the anterior tibial and peroneal vessels in the upper part of their course. The authors prefer continuous spinal anesthesia for the procedure.

The operation is described in detail with illustrations of the technique. There are 15 case reports given with the preoperative findings. It is interesting to note that enlargement of the heart is not present in all cases, but it is found in some of them and seems to depend upon the length of time from the injury to the examination made before surgery.

The authors' conclusions are as follows:
Careful exposure of the tibial and peroneal vessels in the upper part of their course is necessary in the

INTERNATIONAL ABSTRACT OF SURGERY

made it possible to observe the mechanism of flow, turbulence, and the effect of constriction. The axial and peripheral phases of flow could be observed. If a thread introduced into the lumen was small enough to remain in the clear peripheral zone, there was little evidence of turbulence. If the thread, because of its size or length, projected into the axial phase, pronounced turbulence would occur. The effect of a venturilike constriction was also studied and it was found that the turbulence produced distal to the constriction was capable of producing a propagating clot. These findings emphasize the observed facts that when good approximation of the vessel without occlusion or distortion of the vessel is obtained with fine close suturing, no intravascular clot will form and the anastomosis will be successful.

Types of suture material. No catgut of a size comparable to No. 000000 silk is obtainable, and no actual anastomosis of arteries is obtainable, and no catgut ligation tends to produce thrombus formation and intravascular clotting to a greater extent than does ligation with silk. It would appear that catgut would not be a suitable material even if it existed in the necessarily small sizes.

It is emphasized that even though thrombosis may occur postoperatively the process is a slow one which admits of the establishment of an adequate collateral circulation so that the end result physiologically may be the same as though perfect technical results had been obtained. There are only a few technical fundamentals which must be adhered to: (1) use fine arterial needles and silk (No. 000000); (2) keep the suture gap less than 1 mm. (3) approximate the ends accurately; (4) use anticoagulants freely but judiciously; and (5) use mechanical aids, such as the soluble rod technique, when possible.

JOHN L. LUDWIG, M.D.

BLOOD TRANSFUSION

Neefe, J. R., Stokes, J., Jr., and Gellis, S. S.: Homologous Serum Hepatitis and Infectious (Epidemic) Hepatitis. Experimental Study of Immunity and Cross Immunity in Volunteers. A Preliminary Report. *Am J Med Sci* 935: 210, 561.

Homologous serum hepatitis and infectious epidemic hepatitis have several characteristics in common. Both etiologic agents pass through bacterial filters and are not destroyed by heat at 56° C for 30 minutes. Both also produce similar clinical manifestations. However with infectious hepatitis the transmission is common, the causative agent being found in the feces. Epidemic hepatitis may be prevented or attenuated by means of human immune serum, globulin, or human adult plasma. The presence or absence of cross immunity between the two diseases has not been established. Six human volunteers recovered from homologous serum hepatitis and failed to develop any acute clinical manifesta-

tions upon reinoculation of the causative agent of this disease whereas 8 of 9 normal controls developed hepatitis and jaundice. The 6 volunteers were also inoculated with material containing the etiologic agent of epidemic hepatitis and as a result 5 again developed hepatitis. Controls inoculated orally contracted epidemic hepatitis, but the controls which were inoculated parentally did not develop to the disease. The incubation period of serum hepatitis exceeded 60 days, whereas that of infectious hepatitis did not exceed 37 days.

The authors believed that the lack of cross immunity between the two diseases was due to differences in the antigenic properties of the two etiologic agents, which they believe were not identical. In the addendum, it was noted that recently 8 volunteers were found to be resistant to reinfection by the agent of infectious hepatitis for a period of 8 months after recovery from this same disease.

BENJAMIN G. P. SEATON, M.D.

LYMPH GLANDS AND LYMPHATIC VESSELS

Loeake, L., and Craver, L. F.: The Diagnosis of Hodgkin's Disease by Aspiration Biopsy. *Blood J News* 1948: 75.

Biopsy by means of aspiration through a needle has become an indispensable method of obtaining tissue for microscopic diagnosis at the Memorial Hospital, New York. The technique is now well established and the method has been repeatedly described. The authors between, report in detail the steps of aspiration biopsy according to their technique. They state that naturally first care must be used (1) in accurate localization of the tumor by means of straight posteroanterior and straight lateral roentgen films (2) in fluoroscopic check of the position of the point of the needle (3) in avoidance of trauma to the lung (4) in avoidance of any reflux or injection of tumor material or air into the lung or into a blood vessel and (5) in keeping the patient horizontal during the procedure, and very quiet for some hours afterward. Currently, a considerably greater number of intrapulmonary malignant tumors are yielding microscopic diagnoses as a result of aspiration biopsy rather than as a result of bronchoscopic biopsy although the latter procedure is always given precedence unless it would obviously be useless.

Among 243 cases of histologically proved Hodgkin's disease treated at Memorial Hospital for the most part within the past 5 years, the diagnosis was established by open biopsy in 228, while aspiration biopsy yielded a reliable diagnosis in 14 cases. In the 14 cases of Hodgkin's disease in which the diagnosis was made by examination of the sectioned clot obtained by aspiration biopsy the material was from the lymph nodes in 9 cases, from a prestenal node in 1 case, from the lung in 3 cases and from the spleen in 1 case.

Among the 228 cases in which formal biopsy was used to prove the diagnosis aspiration biopsy had

been previously attempted but had been unsuccessful in 11 cases. Thus in 25 cases of the total number of 232 aspiration biopsy had been selected as the first method on trial for good reason and was diagnostically successful in 56 per cent of the group.

The authors conclude that in cases of Hodgkin's disease without enlarged peripheral lymph nodes yet with nodes or masses accessible to needle puncture the method of aspiration biopsy has often proved successful in establishing the diagnosis. Success depends in large measure on examination of a sectioned blood clot from the aspirated tissue by an experienced pathologist.

HERBERT F. THURSTON, M.D.

MISCELLANEOUS

Sarmiento P. B.: Some Consideration Concerning the Surgical Treatment of Elephantiasis of the Extremities (*Algunas consideraciones sobre el tratamiento quirúrgico de la elefantiasis de los miembros*). *Rev. esp. cir. traumat. ortop.* 1945 3: 145

The majority of authors agree that a primary infection of the lymphatics predisposes to a septic infection which in extreme cases may lead to elephantiasis. The condition is characterized by an exudate rich in leucocytes, fibrous hyperplasia and thrombosis and obliteration of the blood vessels in the subcutaneous tissues. In many instances no streptococci or parasites can be found and a special susceptibility of the lymphatic or lymphovenous system must be assumed. The causes of such abnormal conditions of the lymphatics may be of a local or general character.

As to the treatment of the condition Cornachan suggested ligation of the main artery but the resulting necrosis soon discredited this operation. Winthorpe recommended a gradual compression of the main arteries but the same objection may be raised to this procedure as to ligation of the main artery. Buchman suggested ligation of the main vein of the involved extremity while Leriche recommended a periaxillary sympathectomy basing his recommen-

dation on the hypothesis of the existence of sympathetic fibers in the lymph vessel walls. Rogers advocates extensive removal of the involved tissues and insists upon the necessity of repeated interventions. Hanley described a procedure which he calls "lymphangioplasty," consisting of the introduction of silk fibers into the affected zone and extending them into normal regions. In this manner he expected to establish artificial capillary drainage from the involved to the healthy tissues. Le Dantec supplemented Hanley's procedure by immunization with a certain vaccine. Walther buries rubber tubing in the involved tissues while Lanz extirpates extensive portions of the tissues and introduces fascial strips in order to establish drainage. Kondoleon suggested an extirpation of the aponeurosis in order to facilitate deep drainage. Payr and Oppel described similar methods. Castellani advocates daily injections of fibrinolytic or acetosalicylic thiosinamine. Mata recommends the administration of streptococcus vaccine before any operative intervention.

The author operated on a 39 year old woman who developed a suppurative process in both inguinal regions at the age of 15 years. Following these lesions a tremendous elephantiasis of both lower extremities gradually developed. The author believes that repeated infections in the form of dermatitis, probably of a streptococcal origin led to an infection of the lymph glands and lowered the resistance of the skin. Apparently repeated dermatitis with resulting lymphangitis produced cutaneous alterations and changes in the lymph vessels.

As to the treatment the author employed a procedure consisting of resection of a large amount of tissue. He followed Sistrunk's technique modified by Kondoleon. In extensive cases of elephantiasis the operation must be performed in stages.

The author resected 9.5 kgm. of tissue under spinal anesthesia from the left extremity and a similar amount from the right extremity. Catgut No. 0 was used for ligatures and the tissues were approximated with catgut No. 3. A check-up 8 months later showed very satisfactory results.

JOSEPH K. NARAT, M.D.

SURGICAL TECHNIQUE

OPERATIVE SURGERY AND TECHNIQUE POSTOPERATIVE TREATMENT

Ivancov, C., Jr.: *The Hypochloremic State in Surgical Patients*. Surgery 1945 18 535

Four cases are presented which illustrate an exception to the rule of withholding salt administration postoperatively. These cases are examples of severe hypochloremia following extensive burns, persistent vomiting from pyloric carcinoma, chronic high intestinal obstruction, and biliary obstruction, respectively.

The condition of hypochloremia is equivalent to heat exhaustion passing into the subacute or chronic phase due to persistence of the chloride loss. Clinical recognition of the hypochloremic state is difficult because of its rarity and the bizarre clinical picture it presents. The conditions most commonly associated with the loss of large quantities of electrolytes are gastrointestinal drainage, pyloric obstruction with vomiting, persistent external biliary fistula, high intestinal fistula, extensive granulating surfaces, persistent fever and excessive sweating from a long operation during sultry weather.

The clinical manifestations of the hypochloremic state may be classified as either prodromal or advanced. The advanced symptoms are acute and prostration. They are usually characterized by a blood pressure of 80 or below, and a soft, easily compressible pulse which is almost unobtainable. The skin is cold and clammy and excessive thirst is accompanied by extreme weakness and prostration is common.

The acute advanced symptoms may be preceded for several days by the prodromal symptoms which consist of mild cramplike persistent abdominal pain, nausea, moderate abdominal distention, and repeated vomiting of small amounts of bile stained fluid. The patient may appear languid or drowsy and may develop an intractable hiccough. Anorexia is almost always present, and bowel movements and flatus are absent. Oliguria and uremic symptoms are fairly constant. The clinical similarity of the hypochloremic state to the picture presented by salt intoxication—the acute abdomen, postoperative ileus and intestinal obstruction due to nutritional edema—makes it extremely difficult to differentiate these conditions, except for the finding of a low blood chloride in the clinical conditions mentioned.

The importance of early diagnosis of the hypochloremic state is apparent, since the condition may rapidly progress to fatality from an extreme shock like state with uncompensated alkalosis and extrarenal azotemia. Active therapy consists of massive fluid and salt administration preferably by the

intravenous route. Shock due to the acute hypochloremic state will not respond to the usual administration of blood plasma, and non-specific intravenous fluids. The Collier clinical rule for salt replacement and daily blood chloride determinations are accurate guides to treatment.

JOHN L. LINDQUIST, M.D.

Starr, L., and Mayrock, R. L.: *Convalescence from Surgical Procedures. Studies of the Circulation Lying and Standing, of Tremor and of a Program of Bed Exercises and Early Rising*. Am J Surg 1945 10 701

The purpose of the authors' investigation was to search for objective abnormalities during convalescence from surgical procedures by a available special techniques and by other methods which might be devised. If one could discover objective abnormalities they might be used as a test for the duration of convalescence and also as a means of judging the success or failure of attempts to shorten the convalescence which was also part of the authors' project. In planning the work the authors expected that few abnormalities would be found when convalescent subjects were studied at rest, but when they were asked to perform tasks, it was expected that abnormalities would be discovered. For such tests, tasks that the patients were accustomed to were preferred. The first test consisted of observing the changes in the circulation which took place on arising, the second of studying the effects of mild exercise, that of pushing up and lowering a weight. The results of the latter are reported elsewhere.

Forty-four patients were studied before and repeatedly after surgical operations. The test used consisted of estimates of the pulse rate, blood pressure, and cardiac output (ballistocardiogram) under standard conditions in both the horizontal and vertical positions.

The average of the results obtained in 25 cases operated upon for hernia disclosed that the following significant changes occurred during postoperative convalescence:

In the horizontal position the cardiac output was diminished soon after operation, and the blood pressure was diminished later. In the vertical position the pulse rate was increased, the cardiac output tended to be increased and the systolic blood pressure tended to be diminished.

The difference between the lying and standing pulse rates increased, and the ratio between the lying and standing cardiac outputs was changed after operation. There was more tremor after operation. The subjects were unable to remain standing after operation.

After more serious operations the changes found in convalescence were generally similar to those described after herniorrhaphy with two exceptions

(1) the administration of large amounts of fluid by vein prevented the postoperative fall of the cardiac output or caused it to increase, and (2) when the operation permitted better nutrition of the patient improvement from this cause far overbalanced the effects of the operation per se.

JOSEPH K. NARAT, M.D.

ANTISEPTIC SURGERY TREATMENT OF WOUNDS AND INFECTIONS

Lalich J. J., and Mason J. M., III: Resuscitation of Severely Wounded Casualties. *Surgery* 1945 18 747

During the North African and Tunisian campaigns and the Anzio-Nettuno beachhead operation in Italy a great number of severely wounded casualties were observed. Many men came into the receiving tent with a blood pressure of 0/0. Their condition was judged by the manner in which they responded to transfusions of plasma and whole blood. It was believed that in cases in which the systolic pressure rose to 80 mm. of mercury and remained at that level the chances that the individual could undergo a major operation would be quite satisfactory. However in cases in which there were compound head injuries, penetrating wounds of the chest or abdomen, or compound injuries of the femur it was more difficult to get the casualties prepared for surgery. It was felt that plasma or blood could be given fairly rapidly. When the desired systolic pressure was not maintained reasonably, the patient was given a high priority for surgery. Hemorrhage was the greatest cause of a drop in the blood pressure in this group. Infection and cardiorespiratory embarrassment must be combated intelligently in association with severely wounded casualties. If and when the systolic pressure dropped in the preoperative and surgical phases of treatment, during the time blood or plasma was being injected the drop in pressure was combated by increasing the amount and rapidity of the infusion.

When the systolic pressure reaches 100 mm. the patient should be given an additional 500 to 1,000 c.c. of blood, either preoperatively or during surgery before resuscitation is considered adequate.

Three cases are reported in detail to illustrate the points brought out.

RICHARD J. BERNETT, JR., M.D.

Rawles, B. W.: A Routine for Early Skin Grafting of Deep Burns. *Surgery* 1945 18 696

This article presents the experience in the treatment of a group of 154 patients with burns in an overseas U.S. Army General Hospital in Italy during a period of 14 months. Forty-two or 27.3 per cent of the burn cases, required grafting as compared with 54 per cent of a group of 78 burn injuries previously reported the great difference being due to the position occupied by the hospital in the chain of evacuation during the two periods. In a number of instances the burns were associated with injuries

of the nerve bone and soft parts since 33 per cent of the patients had been wounded in action. The author's study deals primarily with the late management of deep burns since a majority of this group received the initial treatment in other medical installations and were transferred to this hospital from a few days to several weeks after the injury.

The control of infection is of paramount importance at this time if prompt healing with early and successful grafting when indicated is to be accomplished. Infection besides jeopardizing the life of the patient complicates the successful treatment of burns in the following ways: (1) the healing of second degree burns is delayed; (2) deep second degree burns with sufficient viable epithelium for complete coverage may be converted into third degree burns; (3) in third degree burns deeper destruction of tissue occurs with an increase in scar tissue formation; (4) grafting may have to be delayed unnecessarily and may even be unsuccessful and if so is followed by the formation of more scar tissue and contractures; and (5) even after the successful take of grafts, furuncles and pustular infection delay the healing of small uncovered inbetween areas and destroy portions of viable grafts days or weeks later. The problem therefore in burn therapy after shock has been overcome is to control infection and obtain a closed wound as rapidly as possible either by the healing of undestroyed epithelium or by skin grafting.

Penicillin is used in the primary treatment of burns and is given intramuscularly in doses of 25,000 units every 3 hours. Infection is controlled in the majority of cases, provided the primary dressing is left undisturbed for from 12 to 14 days. It is the author's impression that oral sulfadiazine is just as dependable as penicillin during this stage of the treatment. Any drug therapy is only an adjunct to good surgical management (originally described by Allen and Koch) and briefly consists of (1) meticulous cleansing of the burned surface and (2) a resilient pressure dressing with fine mesh grease gauze next to the burned surface. This should not be changed for from 12 to 14 days. Care is taken to splint adjacent joints and in the case of the extremities, to see that the pressure dressings begin at the toes or finger tips and extend well above the burned area. Elevation of temperature occurs when this routine is used but only on rare occasions is it necessary to change the primary dressing any earlier than 12 to 14 days for the purpose of inspection. All dressings are done in the operating room under strict surgical technique and if the burns are at all extensive, with the aid of an anesthetic. A majority of second degree burns are found healed when the primary dressing is removed and there is only minimal contamination or infection in the case of deep burns. All loose, dead skin and the tops of unbroken blisters are removed in unhealed second degree burns, and a second petrolatum gauze dressing is applied and left undisturbed for another period of 10 to 14 days. Healing is complete in the majority of the remaining patients when the second dressing

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is removed, except when there are areas of full skin destruction present which had not been previously recognized.

The recognition of full thickness burned skin and its prompt removal is necessary if grafting is to be done early. The identification of nonviable skin by means of sodium fluorescein and the excision of such areas, followed by immediate grafting when the burn is first seen or at the time the first or second dressing is done, has been suggested. The practice is to excise all or as much demarcated slough as possible at the time of the first change of dressing and thereafter at intervals of 3 or 4 days until all of it is removed.

In the author's experience moisture often seemed to enhance the growth of bacillus pyocyaneus, and to surrounding skin edges. In June, 1944, at the suggestion of Lyons, he began applying dry fine mesh gauze pressure dressings after the last slough had been removed, and continued or began giving penicillin intramuscularly in doses of 25,000 units every 3 hours. The dressing is left undisturbed until the patient is taken to the operating room 4 to 6 days later for grafting. The additional time is used to bring the blood values to normal with transfusions of blood or plasma, as indicated.

The following advantages result from this routine. First, infection is controlled, second, grafting is more successful since infection is controlled and also because this routine makes earlier grafting possible. Third, the patient's discomfort is greatly reduced by this simple routine. Fourth, scar tissue and resulting contractures are diminished by early grafting. Fifth, the amount of dressings, drugs, and other supplies necessary for treating a burn is reduced, medical personnel are freed for other duties, and many days of hospitalization are saved.

When this technique is used the burn wounds are found covered with healthy granulations at the time of grafting, although 4 or 5 days previously the action was carried down to subcutaneous tissue. These granulations are not disturbed. However in the patients admitted late, it is often necessary to cut the exuberant granulation away. Split-skin grafts are always used, and are removed either with the Padgett dermatome or with a modification of the Blair Brown knife in place except in the case of large grafts where a roller attachment. Grafts are not sutured in place except in the case of large grafts to the original size (to do so if the stretch of the skin to the original size is to be obtained). It is the experience of the author that grafts become firmly adherent within a few minutes after being placed, because the necessary substances for adherence are present in the wound itself.

Furuncles and postural infection is and about the grafted area can often be a problem. A wet dressing spreads the infection, macerates the skin, and many times leads to pyocyaneus and proteus contamination. All of this delays the healing-over of small inbetween areas or uncovered edges which are sometimes present when an extensive area must be

grafted. In the author's experience, penicillin given periteneally does not control such infection when petrolatum gauze or wet dressings (with saline solution) are used. In fact, oral sulfadiazine seems to be more effective under these conditions. Recently however penicillin dressings have been used on the grafted area after the initial change of dressing when there has been much infection present. Strips of fine mesh gauze are wet with a solution of 350 units of penicillin to each cubic centimeter of normal saline solution and placed over the grafted wound. This is sealed over with petrolatum gauze to prevent too rapid absorption of the solution by the overlying dry dressing, and is changed once daily until the infection is controlled. This seems like a paradox since infrequent change of dressings during the acute stage of the burn, and previous to grafting is stressed as being very necessary if infection is to be controlled. When dressings are not changed for 3 or 4 days, destruction of previously viable grafts results from the accumulation of pus, if pustules or furuncles are present in the grafted area. Furuncles and postural infection after grafting were reduced by the use of penicillin dressings.

John E. KEMPENACK, M.D.
Rubin, L. R.: Contiguous Skin Flaps for Wounds of the Extremities. *Am. J. Surg.* 1944, 7, 34.

Closure of avulsed wounds in which the loss of skin and deep tissue is extensive may be effected by the use of tube and flap grafts, or by means of contiguous skin flaps. The author attempts to summarize, with the aid of drawings, photographs, and charts, his experience with 50 selected war wounds of the extremities closed by the various contiguous skin flap techniques.

The skin adjacent or contiguous to a wound is mobilized by the use of planned incisions which permit the contiguous skin to cover the defect after advancement, rotation, or transposition of the skin flap. Often extensive undermining opens large areas of these to bacterial invasion, but chemotherapy particularly with penicillin, reduces this hazard. The author has also made use of multiple transpositions, where indicated, to aid wound healing.

This technique is applicable to wounds requiring new skin tissue which (1) will cover exposed bone, tendon, or deep irregular muscle defects, (2) will not adhere to underlying muscle when fascia is missing, and (3) will not contract. However it is pointed out that skin manipulation beyond a certain point will compromise the blood supply as to limit the use of the flaps must contain all layers (fat down to the deep fascia). The flaps are most successful where the skin is lax, as on the abdomen, back, and face. Only clinical judgment determines the limits of undermining for safe closure.

Buried absorbable sutures along with plaster of Paris splints are used to relieve the tension at the edges of a wound. Planned incisions are made along Langer's lines, and irregular wounds are transformed

into geometric designs (triangles and rectangles). Closures are effected to give figures H, Y, Z, T etc. Wherever the position of the flap necessitates cutting across the main sources of blood supply the author employs the technique of "delaying" which uses the principle of a gradual, rather than a sudden reduction of blood supply. The flap after being outlined through the skin, subcutaneous tissue and fat, is completely lifted from its bed, only to be replaced immediately and resutured in its former position until the blood supply at the base becomes adequate. This may require multiple stage operations.

Local anesthesia, even without adrenalin should never be used. The injected fluid acts as a mechanical barrier to capillary circulation and of course adrenalin is contraindicated because of its vasoconstricting action. Brachial block for the arms and spinal anesthesia for the lower extremities are recommended. For individuals with a high vascular tone, who are sensitive to the vasoconstrictive effects of cold, pain, and trauma use is made of lumbar paravertebral block (below) and stellate block (above).

Direct heat to an ischemic area favors necrosis because the local metabolic needs are more greatly increased than is the blood supply. Nevertheless, heat applied to the trunk of the body is beneficial by virtue of reflex vasodilatation in the extremities without an elevation of the local metabolic needs.

In instances of associated nerve injury it may be best to use a split skin cover immediately and to defer the flap closure until the nerve has been repaired.

The contiguous skin flap is designed primarily for utility and no attempt is made to obtain a cosmetic result.

DAVID H. LYNN, M.D.

Newman, P. H.: Early Treatment of Wounds of the Knee Joint. *Lancet* Lond., 1945 249 632.

This article deals with the treatment of wounds of the knee joint. The author classifies these wounds as slight, moderate, and severe, of which there were 10, 39, and 8 respectively. He discusses the diagnosis of the type of joint injury and the treatment.

In the first group aspiration, intra-articular penicillin, and immobilization by means of a plaster cast was found sufficient. In the second group careful wound incision, primary suture, intra-articular and parenteral administration of penicillin with immobilization and extension in the Thomas splint were instituted. Among the 49 cases in these two groups there was only 1 case which gave him much difficulty.

In the remaining 8 cases falling in the "severe" classification because of the time element and contamination 5 of the wounds were left open. The other 3 were closed and treated the same as those in the first 3 groups.

Foreign bodies were removed at the first operation whenever this procedure was reasonable and possible. A separate incision was found to be necessary in a few cases. The importance of preoperative

roentgenographic films was stressed. The author also calls attention to the fact that nonradiopaque foreign bodies such as wood and glass may be a source of trouble. Frequently the history of the accident will put the surgeon on his guard in the last type of case.

PAUL MERRILL, M.D.

Caldwell, G. A.: Secondary Infection of Wounds. *Ann. Surg.*, 1945 122 645.

Secondary infection following the original infection of an open wound is so commonplace as to pass unnoticed. The average surgeon accepts it as a matter of course and unless the patient's life is endangered or his leg is about to require immediate amputation he thinks nothing need be done to improve the situation. Actually secondary wound infection is the principal cause of delayed healing and impaired function. Moreover such infections are to a great extent preventable and even established infections can frequently be eliminated.

Primary wound infections (to distinguish them from the secondary) are those caused by bacterial contamination at the time of injury. These bacteria are derived from soil, clothing, skin and foreign bodies.

Secondary infections are those caused by bacteria introduced into the wound at any time after the initial injury. These invaders may come from the skin of anyone touching the wound from unsterile instruments or dressings, or from the respiratory tract of the patient or of his attendants. They may fall into the wound with dust from the floor of a ward and may be drawn by capillary attraction through a soggy dressing which is in contact with soiled linen.

Only 5 per cent of fresh wounds were found to be infected with hemolytic streptococci and staphylococci and bacillus pyocyaneus upon admission to the hospital, but after a week in the institution 50 per cent of the wounds contained secondary invaders and later on they were found in from 70 to 80 per cent of the open wounds.

Pathogenic organisms can be eliminated in most cases by the body's defense mechanisms when these are aided by adequate surgical débridement. They persist as serious or trivial infections in from 10 to 25 per cent of cases. They appear as new invaders and produce serious and trivial infections in from 20 to 50 per cent of cases. Of the serious persistent infections developing in wounds probably at least half are caused by bacteria secondarily introduced.

In view of these facts the "laissez faire" attitude of surgeons toward secondary wound infections is not justifiable. Surgeons are correct in placing more emphasis upon the general condition of the patient and adequate drainage but are incorrect when they ignore the changing bacterial flora in the wound under treatment.

Detailed modes of treatment including meticulous operative technique supplemented by the administration of sulfonamides or penicillin before and after operation are described and illustrated by cases.

HARRY W. FINE, M.D.

INTERNATIONAL ABSTRACT OF SURGERY

Birks, P. A.: Infections of the Superficial Palmar Space. *Lancet* Lond. 1945 249 669.

The author presents 5 cases to illustrate the effects of incorrect and correct management of infections of the superficial palmar space. These infections have gained little recognition by virtue of their comparative rarity and the ill defined anatomical nature of the space. The space lies in the hand between the palmar fascia and the flexor tendons, proximal to the transverse crease of the palm. It is doubtful if it exists in the normal hand. According to Inell, the boundaries of the superficial pretendinous central palmar space are:

- Anterior the palmar fascia
- Posterior the tendons and lumbrical muscles
- Internal the fourth intermetacarpal space
- External the union of the palmar fascia with the intermuscular aponeurosis of the second metacarpal
- Proximal the union of the palmar fascia and transverse ligament
- Distal the fusion of the middle palmar spongy

Fluid injected just through the palmar fascia mixes freely with fluid injected through the web of the middle finger into the middle palmar space. However indefinite this space may be in the normal hand a collection of pus behaves as though it was confined between tendons and palmar fascia. In the early stage extension of the infection occurs principally through the palmar fascia.

Clinically in from 3 to 10 days after injury the hand becomes painful and the palm swollen especially proximally and a purulent blister collects under the skin. The fingers are semiflexed, active movements are restricted and painful there is little edema of the dorsum but a great general upset. The abscess should be opened before the palmar fascia sloughs (that is, early) under unhurried anesthesia and with a tourniquet. The incision should be over the most prominent part of the swelling and along the line of the crease. The fascia is opened with alnus forceps. The superficial palmar arch under the fascia is pushed out of danger by the pus. Tubercare unnecessary for drainage. The after care consists of

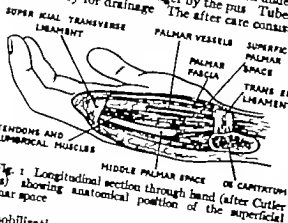


Fig. 1 Longitudinal section through hand (after Cutler 1945) showing anatomical position of the superficial palmar space

immobilization on a wire splint with frequently changed dry dressings.

DAVID H. LYON, M.D.

Pratt, E. L.: Clinical Tetanus. *J Am Med Ass* 1945 129 1243

The classification of 56 children with tetanus in the order of the severity of their infection was of use in evaluating the methods of treatment employed. There was no evidence that amounts up to 80,000 units of tetanus antitoxin was more effective than amounts of 30,000 units. The intrathecal administration of tetanus antitoxin was probably but not definitely more effective than the intramuscular or intravenous administration of the same amount of antitoxin.

Fatal reactions occurred from tetanus antitoxin given intrathecally to some patients, who in all likelihood, would otherwise have survived their tetanus infections. Hence, tetanus antitoxin should not be used intrathecally in any but the most severe cases, if it should be used at all, until a preparation is available which is incapable of producing severe reactions.

Excision of the site of infection, once clinical symptoms of tetanus were present, did not ameliorate the course of the disease.

SIMONE KAHN, M.D.

Noel H. B., and Cole, J. P.: The Bacteriology of War Wounds in the Pacific Area. *U S War Med Bull* 1945 45 1137

A hospital ship in the Pacific area treated 730 fresh battle casualties in a little over one year. Care of all of these wounds was highly desirable, but physically impossible because of the shortness of time, the large number of casualties and the brevity of laboratory personnel. One hundred and sixty-one cases had wound cultures. These were severe wounds caused by shell fragments in 86 patients, bullets in 54, and unknown missiles in 21.

In contrast to civilian wounds, which are usually seen by a surgeon within a few hours these wounds did not receive treatment for from 24 to 48 hours because of the ferocity of battle and the difficulties of transportation. Eighty-three patients in this group had their wounds cultured and were under treatment within 24 hours. An additional 30 patients were seen during the second 24 hour period.

Whenever possible, tissue was taken from the wound for culture. When it was not available, swab cultures were made on blood agar and trypticase, a dextrose-agar stab heated at 70°C. for 10 minutes, a meat infusion medium, a dextrose-agar (unheated), and litmus milk were inoculated.

The authors' attention was centered on anaerobic cultures, and 160 wounds were cultured for anaerobic organisms. Of this group 77 (48.1%) were positive. The most frequent anaerobe cultured was the clostridium perfringens, present in 57 of the 77 wounds. Unclassified proteolytic anaerobes were present in 24 cases, and 23 wounds yielded more than one species of anaerobe. Clinical gas gangrene developed in 27 cases (35% of the anaerobically infected wounds) and in 1 case which failed to yield anaerobes on the

admission culture. *Clostridium perfringens* was the offending organism in 26 cases of gas gangrene while the other case was caused by the *clostridium septicum*.

Direct smears from fresh wounds do not provide a reliable picture of the bacterial flora so one must depend on cultures. Early information is essential particularly in the case of anaerobes, in order to institute treatment before the infection gets out of control. The patients whose wounds yielded anaerobes were carefully observed and the earliest signs of clinical infection detected. This information led to early amputation and probably saved the lives of several patients.

Aerobic organisms were cultured from 120 wounds, and in only 14 wounds were the cultures negative. The *staphylococcus albus* was most often found. Wound infections although frequent, usually remained localized. A case report of a serious complicating aerobic infection is presented.

The value of local implantation of sulfanilamide in the effort to prevent and control infection is doubtful. The authors did qualitative chemical tests on serum from the wounds of patients or on macerated tissue removed at débridement and found that sulfa drugs were present in 60.83 per cent of the wounds from which aerobes were cultured and in 57.14 per cent of the wounds from which anaerobes were cultured. Therefore the local use of sulfanilamide certainly is not bacteriocidal. The value of the drug as a bacteriostatic agent is more difficult to evaluate.

The wounds of 2 patients from which the *clostridium perfringens* was cultured were constantly irrigated with azochloramid solution and sulfadiazine was given orally. One patient, in addition received 640,000 units of penicillin. In spite of this regimen for 9 days cultures of these wounds still yielded the *clostridium perfringens*, although neither patient developed gas gangrene. This would stress the fact that chemical sterilization of a wound is practically impossible. ROBERT R. BICKLOW M.D.

Smith Petermen, M. N. Larson C. B., and Cochran W.: Local Chemotherapy with Primary Closure of Septic Wounds by Means of Drainage and Irrigation Cannulae. *J. Bone Surg.* 1945 27: 563

This article deals with a method of treating septic wounds, whereby the largest part of the wound is closed and cannulae are inserted through the superficial structures down to the septic process. Dakin's solution has been used extensively and even now is often substituted temporarily for other chemotherapeutic agents. Silver pectinate solution has been used in a limited number of cases.

Penicillin has been used for the last year. The technique consists of primary closure of the wound around the cannulae, gauze sponges being packed between the skin and the flange. The dressings stabilize the cannulae. A number of cubic centimeters of penicillin are delivered from the supply

bottle into the wound through the inlet cannula. The outlet cannula is left open until the clear fluid appears, then it is clamped off.

Penicillin is delivered into the wound every 4 hours. The strength of the solution is 250 units per cubic centimeter. The period of administration varies from 2 to 4 weeks. Dressings are infrequent. The cannulae are removed under pentothal anesthesia and the soft tissue defects are closed leaving only a small rubber catheter in place for the administration of penicillin for a few more days. Systemic chemotherapy is used in conjunction with the local chemotherapy. The usual dosage is 100,000 units for 24 hours. Four cases are reported.

CASE 1. A boy 13 years of age had recurring osteomyelitis of the left fibula. The suggested technique was followed and the wound healed completely in one month.

CASE 2. A man 24 years of age had recurring symptoms referable to his right ilium. Roentgenograms showed changes characteristic of osteomyelitis. Operation consisted in sequestrectomy, saucerization and insertion of glass cannulae. The wound healed completely in 5 weeks.

CASE 3. A man 38 years of age had rheumatoid arthritis with a rigid spine and fibrous ankylosis of both hips. In 1934 he had had a fasci lata arthroplasty of the left hip with postoperative sepsis which had persisted for a period of 5 years. During a vitallium mold arthroplasty free pus was encountered in the iliac fossa and treated. There has been no recurrence of sepsis for 6 years.

CASE 4. A man 19 years of age had multiple foci of osteomyelitis occurring over a period of 7 years. In July 1944 acute symptoms from a new focus in the mid-shaft of the right femur developed. Operation included saucerization and insertion of a vitallium cannulae with wound closure. Ten months have elapsed since operation and so far there has been no local recurrence of sepsis.

The authors state that this is not a perfected method with 100 per cent cures. There have been cases with local recurrence of sepsis but these have been relatively few.

A number of figures and roentgenograms showing the method in use are included.

RICHARD J. BENNETT, JR. M.D.

Woodward, F. D. and Holt, T.: The Local Use of Penicillin. *J. Am. Med. Ass.* 1945 129: 589

The local use of penicillin has proved helpful in the control of acute and subacute infections of the nose, sinuses, nasopharynx, pharynx and mouth and has been of occasional benefit in certain cases of chronic otitis media. It has also proved beneficial postoperatively in mastoid and sinus surgery.

It has been of no value in the treatment of acute otitis media, and of negligible or no value in chronic sinusitis and chronic sinusitis associated with allergic rhinitis.

Its usefulness in the treatment of the common cold is still undetermined.

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In those cases in which the local use of penicillin has proved beneficial, its effect will no doubt be enhanced by its combined use systematically or by the combined use of an appropriate sulfonamide.

The local application of penicillin does not produce any dramatic change in the bacterial flora present in the nose and throat. Its effect seems to be more bacteriostatic in nature than bactericidal. In the cases of several patients who had recently recovered from scarlet fever the authors were unable to alter the bacterial flora on repeated cultures after local treatment.

The solution 500 units per cubic centimeter and lozenge provide the simplest and most effective means of application. The water-soluble jelly was useful at times for instillation into the nose at bed time and in the treatment of atrophic rhinitis in which the nasal symptoms were ameliorated.

The authors are hopeful that new antibiotics will soon be available, particularly for the gram negative organisms and for the more common bacteria which have become sulfonamide or penicillin resistant.

JOHN J. MACINTYRE, M.D.

Romanaky, M. J., and Ritzman, G. E.: Penicillin Blood Levels for 24 Hours following a Single Intramuscular Injection of Calcium Penicillin in Beeswax and Peanut Oil. *N. England J. M.* 1945 233 377

A single injection of 500,000 Oxford units of calcium penicillin in 4.5 per cent beeswax (by weight) in peanut oil contained in 1 cc. produces and maintains effective levels of penicillin in the blood for about 24 hours and continues to be excreted in the urine for approximately 3 days.

Calcium penicillin in beeswax and peanut oil maintains its potency for at least 6 months at refrigerator and room temperatures up to 37° C. In addition there is no deterioration after 24 hours at 50° C or after two hours at 100° C.

BENJAMIN GOLDMAN, M.D.

Romana, F. E., Jacobsen, L. Y., and Smith, E. L.: Reactions to Penicillin. *Bull. U. S. Army Med. Dep.* 1945 4 694.

The authors study deals with the serious and unusual reactions observed in some 3,000 soldiers receiving prolonged courses of penicillin. In about 0.5 per cent of this group, the reactions were so severe that the penicillin was discontinued. The reactions are classified as follows: (1) urticaria, (2) convulsions, and (3) angioneurotic edema. (4) a syndrome similar to serum sickness, (5) acute syncope, (6) transient miliarialike eruptions, (7) erythematous eruptions, at times simulating dermatophytosis, (8) erythema nodosum and (9) epiglottitis.

The reactions to penicillin have been of two main types—those appearing shortly after first exposure to the drug, and those occurring at a later date as a result of developing sensitization. Those in the first

group are due to pre-existing hypersensitivity to penicillin which may be inherent or may occur as a result of a previous fungus disease. Those in the second group may occur later in the first course of treatment, shortly after its termination, or at various times during subsequent courses. The reactions in this group are indicative of a developing sensitization to penicillin. Here again, previous fungus disease may enhance the development of reactivity to penicillin.

Both early and late reactions may be serious in nature and require discontinuation of the therapy. From clinical observations, it appears that the primary vascular tissue in most penicillin reactions is the vascular bed.

Intradermal testing with penicillin has been of limited value as an aid in diagnosis or guide for further treatment. Increased reactivity to penicillin may occur on the basis of a previous acute fungus disease.

The presence of negative intradermal tests during and subsequent to some of the more serious reactions indicates that clinical judgment in each case is more important than the information obtained from skin testing.

JOSEPH K. NAKAT, M.D.

ANESTHESIA

Rosenstein, E. A., and Hershberg, S. G.: The Utility of Apomorphine in Clinical Anesthesia. *Anesthesiology* 1945 6 374.

The use of apomorphine as a sedative has been limited and it is the purpose of this report to suggest more extensive use of the depressant properties of this drug for several types of cortical stimulation as seen by the anesthesiologist.

Apomorphine in subemetic doses is a valuable therapeutic aid for such conditions as emergency delirium, acute alcoholic psychoses, or patients with developed or impending delirium tremens, drug addicts, and excitability following the use of bella donna alkaloids.

The hypnotic action of this drug is prompt, dependable and safe. Sedative effects become apparent in a few minutes with the reduction or cessation of agitated muscular movements. The blood pressure, pulse, and respiratory rates are constant with whatever changes may result from the elimination of the state of excitement.

Apomorphine hydrochloride is marketed in tablet form, and is subject to Federal regulation as a narcotic. It is relatively unstable and should be discarded if a greenish tinge is visible when it is diluted. The sedative or hypnotic action of the drug has had little stress in most texts. Present clinical experience shows that subemetic amounts are free from the described hazards of respiratory and circulatory collapse. The drug is readily absorbed from all mucosal surfaces but its action is more certain when given parenterally.

The report is based on more than 500 administrations for the therapy of emergency delirium. It was

also used as premedication for emergency operations complicated by severe excitement and acute alcoholism, delirium tremens and severe agitation accompanying morphia addiction. Another field of usefulness was for the marked muscular and psychic overactivity occasionally seen before operation after the hypodermic injection of scopolamine or atropine.

Six case reports were given in detail illustrating the types of cases which showed response to the drug. It was not given as a substitute for other depressant drugs except in the special circumstances mentioned. Experience with the drug was limited to surgical patients. There were no accidents or untoward effects.

The dose varied from 1 to 2 mgm for the average adult patient. It was dissolved in 10 c.c. of sterile normal saline solution and administered intravenously. It was safe to repeat half the amount if sedation was inadequate after 20 minutes, and the entire initial dose could be repeated should the excitement reoccur after several hours.

The drug was contraindicated when either asphyxia or oxygen want seemed to be the important factor in the excitement or delirium.

MARY KARP M.D.

Koppányi, T: Acetaldehyde a Volatile Anesthetic and Sympathetic Stimulant *Anesthesiology* 1945, 6: 603.

This report concerns the effect of acetaldehyde when administered by inhalation. The product used for the study was freshly distilled from paraldehyde in the presence of sulfuric acid and water and adult dogs were the subjects. An undiluted or 30 per cent aqueous solution of acetaldehyde was applied by means of a cone or towel wrapped around the nostrils and mouth. Anesthesia was established within 5 minutes, the trachea cannulated and the common carotid artery exposed and cannulated for recording the blood pressures.

Recovery usually occurred within an hour and was uneventful. Toxic effects of an overdose included profound cardiac slowing which was in part due to central vagus stimulation and idioventricular rhythm. Conventional resuscitating measures were usually successful in saving the animals.

Preliminary medication of morphine or barbiturates reduced the quantity of acetaldehyde needed for the anesthesia. The rate and depth of respiration were increased and there was a substantial rise of the blood pressure. There were sympathetic stimulating actions of the drug in addition to the central depressant action, for it produced all signs and symptoms of typical thoracolumbar autonomic excitation such as pupillary dilatation, relaxation of the diaphragmatic muscles and dilation of the bronchial musculature.

The drug is a local irritant to the skin and mucous membranes, but this action is less than that of chloroform. Its odor may be made less offensive by the addition of various volatile oils or ammonia

water. Acetaldehyde ammonia is a pressor agent and a general sympathetic stimulant, while acetaldehyde sodium bisulfite is not. The inhalation of concentrated acetaldehyde vapors is likely to produce cardiac, vascular and respiratory toxic effects.

MARY KARP M.D.

Thornton H. L. and Rowbotham S. Anesthesia in a Maxillofacial Surgical Unit with the British Liberation Army *Anesthesiology* 1945 6: 580

This article is based on the problems encountered and the anesthesia method employed on 1,687 patients with maxillofacial injuries as encountered by one maxillofacial unit in England during World War 2. The types of injury usually found were classified into the blow-out injury, the through and through injury to the maxilla with disorganization of the nasal passages, the retained foreign body in the tongue, the brawny neck, edema of the glottis, direct involvement of the glottis and larynx and injury involving soft tissue alone.

The premedication for the average case was omnopon (grain 1/5) and scopolamine (grain 1/150) given subcutaneously 1 hour before or intravenously a few minutes before the operation. The nose was cannulated just prior to the injection of anesthesia and the larynx under direct vision prior to passing a tracheal tube.

Induction presented the greatest problem in this type of anesthesia because of the difficulty of placing a mask on the face. The airway was often obstructed partially or completely and there was a tendency to laryngeal spasm. Anesthesia by inhalation was found difficult and intravenous anesthesia was the obvious alternative. A 1 per cent solution of bromethyl (avertin) in 5 per cent glucose when given intravenously produced rapid anesthesia which was highly satisfactory for intubation. The solution was warmed to blood heat and tested with Congo red before use. No laryngeal spasm or strangling was observed in any of the cases and there was early relaxation of the jaw.

Intubation was safely effected in the early second stage. The dosage infused varied considerably but the average case was intubated on 300 c.c. There was no cause whatsoever for anxiety regarding the safety of the drug in the cases presented, with the exception of 1 case which was reported in detail. Death may have been due to primary heart failure.

For intubation the nasal route was most commonly chosen and the procedure was carried out under direct vision in almost all cases. The endotracheal tubes used were plasticized polyvinyl chloride (portex). The advantages of this type over the standard rubber type were the remarkable durability of the tubes, ease of sterilization, freedom from kinking, reduced irritability to the larynx which permitted the lightest possible anesthesia and the unusual property of the material which enabled it to be modified to individual requirements after it had been softened by boiling.

INTERNATIONAL ABSTRACT OF SURGERY

A wide-bore endotracheal connection which connected the tubes to the anesthesia apparatus was described. The author preferred packing off the pharynx under direct vision with a 3 inch open woven bandage soaked in liquid paraffin rather than the inflatable cuff.

The technique of anesthesia used for several types of injuries was described. Care was taken to treat hemorrhage and shock and to stabilize the patient's blood pressure at 70 mm of mercury or above before the operation was started. Great stress was laid on the need for providing an unobstructed airway in all cases. Sometimes intubation and tracheobronchial suction without anesthesia was necessary to take care of the anoxic emergency.

Pentothal was employed before bromethyline came into use. The technique of its use was described. The tendency to laryngeal spasm was the main drawback to this agent. Although preliminary tracheotomy under local anesthesia was the main procedure in cases of injury to the larynx, edema of the glottis, and heavy edema of the tongue prior to the induction of general anesthesia was an open question among anesthetists. Deliberate tracheotomy was performed as an emergency.

The anesthetic was kept as light as possible throughout the procedure so that the return of the reflexes was as rapid as possible. The maintenance of the anesthesia once induction was completed was usually carried out by a closed technique of carbon dioxide absorption with nitrous oxide-oxygen ether cyclopropane or ether with the Oxford vaporizer. When the anesthesia was terminated every effort was made to provide and maintain a free airway. Often tracheotomy was performed after the operation was completed. The nasal, pharyngeal or oral airway was always left in place in those patients who did not have tracheotomy. The postoperative care of the patient was of utmost importance and revolved around the maintenance of a free airway. In some instances it was necessary to retain the endotracheal tube for periods of time before it was removed. The patient was placed on his side with the head slightly extended, until fully conscious. Suction was always available and care was taken not to depress the respiratory center with too much sedation.

A short recovery period was considered essential, as was individual skilled supervision until the patient was conscious.

LIVINGSTON H. M.: The Present Status of Ethylene Oxygen Anesthesia. *Ann Surg* 945 1:4 1971

The data presented concerns a general evaluation of 18,150 operations done under ethylene anesthesia in which 11,560 cases had ethylene-oxygen alone. A detailed study was made of the last 3,310 consecutive operations done under ethylene-oxygen. The history of the drug was described extensively and the present physical, physiological, and pharmacological results of its use were reviewed.

As to the fire and explosion hazard of the agent it was concluded that the drug showed the same inherent explosive quality that is present in all inhalation agents except chloroform or nitrous oxide. The author emphasized the quiet smooth induction of the anesthetic, the lack of effect on the red cells, hemoglobin, and the coagulation time or character of the blood clot, and the carbon dioxide combining power of the blood. Blood urea, and icteric index. The reaction to ethylene-oxygen was found to be only moderate without asphyxia, and was limited to the second plane of surgical anesthesia.

The amplitude of the contractions of the stomach, small intestine, and colon were increased without change in tone, and there was depressed gastric secretion with delay in the emptying time of the stomach. Death was due to asphyxia with respiratory failure before cardiac failure.

Ethylene produced no spasm due to direct irritation. Electrocardiograph studies showed no evidence of disturbances in cardiac automaticity or conduction. There was no marked stimulation or depression of the vagus center. Ethylene and procaine gave the lowest incidence of arrhythmias in human beings.

There were no anesthetic deaths reported in the series.

Premedication included morphine sulfate (gm 0.010 to 0.015) given hypodermically and calcium nembutal (gm 0.18 to 0.27) per rectum given 1½ hours before anesthesia.

A detailed tabulation was made of the 50 deaths which occurred following the 3,310 operations. The author believed that an excellent test of the drug was made in the series reported because of the major character of the surgical operations performed. There was a notably low incidence of circulatory and respiratory complications. Vomiting was minimal in comparison with ether.

The author concluded that ethylene-oxygen seemed to be definitely a preferable inhalation agent for the poor risk patients including those with cardiopulmonary mechanisms. The reported death rate of ethylene was lower apparently than that of any other inhalation agent. The main drawback of this anesthetic was its deficient muscular relaxation for the average patient.

FLIEB, G.: Percutaneous Spinal Anesthesia Combined with Evipal Narcosis. *Acta chir scand* 1945, 9: 537

The author reports 500 spinal anesthetics with pericaine (nupercaine) in 1 to 1500 dilution combined with evipal narcosis. The method affords ideal working conditions in abdominal surgery, without extension of the spinal anesthesia to dangerous heights. It reduces the risk of both individual patient. It is humane especially for the anxious should a critical condition arise because the needle is in place in the vein. It presents no complicated apparatus, and it secures a more placid awakening.

Length of spine
cm.Percaine
Male Female

56	18	6
54	17 15	15-16
53	17	15
50	16	14
48	15	13
46	14-15	12-13
44	13-14	11-12
42	13	11
40	12	10

The technique is described in detail. One and one half cubic centimeters of tetracaine (2% solution) (similar to pantopon) and 10 cgm. of ephedrine were given subcutaneously before operation. The patient was placed in a lateral decubitus position and spinal tap effected. The volume of percaine given was determined by means of the above table.

The solution was injected at the rate of 4 c.c. per minute. The needle was left in place in the subarachnoid space and after from 5 to 10 minutes the height of analgesia was tested. If the analgesia was too low a supplemental dose of from 2 to 6 c.c. of percaine solution was administered the needle removed, and the patient turned on his back in a horizontal position or in a few degrees of the Trendelenburg position. Infusion was then initiated and epinal sodium in a 10 per cent solution was injected at approximately 1 c.c. per minute. The aim as a rule was to keep the patient dozing. Saline solution was administered to maintain patency of the needle.

In 91.2 per cent of the cases the effect of the combination of drugs was considered ideal. 8.2 per cent were considered to have a moderate effect and 0.6 per cent had a poor effect. The effect was poorest in men in the age group between 30 and 40 years and in operations above the umbilicus. In 4 cases the epival produced a mild excitation.

The dose of percaine averaged 19.4 c.c. in men and 17 c.c. in women in operations above the umbilicus and 16 c.c. and 15 c.c., respectively in operations below the umbilicus. The largest dose was 32 c.c. administered to a man of 37 years for gastrectomy. The average dose of epival was 8.6 c.c. Twenty-three patients slept satisfactorily on 3 c.c. 15 on 2 c.c. and 1 patient even on 1 c.c.

Complications arising from the combination were few. The blood pressure in most cases remained constant in spite of limited usage of the Trendelenburg position. Eighty-seven per cent of the cases showed a partial fall which did not exceed 30 per cent. 10.8 per cent exhibited a fall between 31 and 50 per cent and 2.3 per cent exhibited hypotension of over 50 per cent. In most cases no changes were demonstrable in the respiration and the pulse also remained unchanged. Vomiting occurred more rarely than in spinal anesthesia alone. Headache was present infrequently.

In 15.6 per cent of the cases the postoperative retention of urine exceeded 24 hours. This high percentage was considered possibly due to the wide use of morphine medication. There were 4 deaths during

the first 24 hours but in no case was anesthesia considered a factor. One death which is perhaps ascribable to the combination anesthesia occurred before the operation was completed.

Parathesia occurred in 1 patient on the seventh day after operation. It was localized to the radial side of the right thumb. Pneumonia was a postoperative complication in 4 cases, 3 of which had a fatal outcome on the seventh, ninth and eleventh days respectively.

The drawbacks to the method include the somewhat long preparation, the need for an experienced anesthetist besides a nurse at the head of the patient and the possibility of unilateral anesthesia.

The method was contraindicated in liver damage, shock conditions and severe morbus cordis, sepsis, tuberculosis and syphilis. MARY KARP, M.D.

Fairclough, W. A. Sixth Nerve Paralysis after Spinal Analgesia. *Brit. M. J.* 1945, 3: 801.

The author briefly reviews the literature concerning the occurrence of sixth nerve paralysis following spinal analgesia, and reports that in a series of 2031 spinal anesthetics 10 instances of partial paralysis were noted. Of all cranial nerve palsies following spinal analgesia, abducens paralysis constitutes well over 90 per cent of those reported. The various theories which have been advanced to account for the vulnerability of the abducens nerve are listed and all of them attribute it to the purely anatomical disadvantages of this nerve.

A new theory is then suggested as to the possible cause for the frequent paralysis seen in this nerve. The factors necessary in binocular stereoscopic single vision are listed and the frequency of some disturbing factor in this complex mechanism is mentioned. Phylogenetically binocular vision is a recently acquired sense and presumably the first lost. The early occurrence of diplopia in unpremeditated inhalation anesthesia and in inebriation is mentioned as an example of the upsetting by a toxic substance of the normal physiological balance necessary for binocular single vision. It is pointed out that the normal power of adduction of the two eyes is three times as strong as the power of abduction. Esophoria is a common form of muscle imbalance. The loss of a part of the tonic impulses conveyed by the abducens nerve could then easily upset the balance and make manifest a squint that had been latent until the introduction of the spinal anesthetic. To explain why most such pareses are unilateral the author states that when the effort to maintain binocular vision is abandoned the second eye is often able to carry on monocular movements normally with the less powerful stimulus being transmitted over the abducens nerve.

Ten cases of partial transient unilateral paralysis of the abducens nerve following spinal analgesia (spinal percaine 1/200—from 1.5 to 3 c.c.) are reported with brief abstracts. Nine of the patients examined after their vision was subjectively normal had an esophoria varying from 1 to 5 I.D. at 6

meters and none had exophoria. The diplopia appeared in from 5 to 21 days after anesthesia and persisted from 2 weeks to 14 months. Covering the affected eye gives relief but is not advised as the removal of the stimulus toward fusion and the re-development of binocular vision is thought to retard recovery. Dark glasses with a covering over the outer third of the glass covering the affected eye are recommended. Muscle exercises and fusion training may be found necessary in those cases in which a natural recovery is delayed.

THOMAS DOUGLASS, M.D.

Engstrand, L. and Friberg, O : On the Function of the Liver as Affected by Various Operations and Anesthetics. *Acta. chir. scand.* 1945 91 3

The liver function was studied postoperatively by means of a series of tests of hippuric acid synthesis (intravenous test) in association with a number of different operations and forms of anesthesia. There was a considerable dissertation on the physiology of the liver and the methods available for the study of its function.

The first group of experiments was made on cases subjected to high spinal anesthesia. It was shown that there was a reduction in the liver function in those cases of high spinal anesthesia (with perclaine) in which a fall in the blood pressure occurred. The cause was considered to be an anoxic injury to the liver.

No reduction of liver function was found with inhalation narcosis with ether a fairly great reduction was observed persisting in most cases for more than a week after the operation. In abdominal operations ether narcosis always appeared to reduce

the liver function even when there was a high glycogen content in the liver during the narcosis and when an adequate supply of oxygen was given during the anesthetic.

The reduction of the hippuric acid synthesis varied according to the magnitude of the operation. Cyclopropane was the anesthetic which was least harmful to the liver even in cases showing a strong reduced liver function preoperatively.

When narcotol nitrogen-monoxide (nitrous oxide) was used with from 15 to 20 per cent oxygen or less, a decrease in the liver function test was manifested, but none appeared when the oxygen administration was 20 per cent or over.

Preoperative and postoperative management with respect to the liver was discussed and the hippuric acid test evaluated. In the cases with strongly reduced liver function it was found important to treat the liver preoperatively for from five to seven days with carbohydrates and proteins, fats being excluded from the food. Glucose was then given subcutaneously on the morning of the operating day. Cyclopropane was considered the anesthetic of choice and an abundant supply of oxygen was continued throughout the operation. Postoperatively a glucose drip was retained for from 4 to 6 days and plasma transfusion was administered in the cases with disturbances of the serum protein content. From the third postoperative day on, fat was included in the food along with a high carbohydrate diet. Although cyclopropane was the agent of choice in these cases, local anesthesia plus narcotol nitrogen monoxide oxygen could be employed if adequate oxygen was administered throughout, but ether was definitely contraindicated.

MARY KARP M.D.

MISCELLANEOUS

CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Curtis, G. M., and Fertman, M. B.: Blood Iodine Studies. *Ann. Surg.* 1945, 130: 963

This paper is one of a series of reports on fundamental metabolic studies. The relation of the basal metabolic rate to the blood iodine in a large variety of thyroid diseases was investigated.

The authors conclude that the basal metabolic rate is a more reliable test of thyroid activity than is the estimation of the level of the unfractionated whole blood iodine. However they state that both determinations, considered together are superior to either one alone.

Although the basal metabolic rate is elevated in all forms of toxic goiter, it is increased more in exophthalmic goiter than in any other form of goiter with hyperthyroidism despite a similarity in the extent of increase of the average unfractionated whole blood iodine in all forms of toxic goiter.

DAVID H. LYNN, M.D.

VanOrdstrand, H. S., Hughes, R., DeNardi, J. M., and Carmody, M. G.: Beryllium Poisoning. *J. Am. Med. Ass.* 1945, 139: 1084.

A disease entity beryllium poisoning has been encountered in workers in the beryllium industry. In three plants in the Cleveland area 170 workers have been affected by dermatological and/or respiratory tract manifestations of this disease. When the respiratory tract is involved the disease may progress to a syndrome resembling chemical pneumonitis. This development caused the death of 5 workers.

JOHN J. MALONEY, M.D.

Schafer, P. W.: The Etiology and Treatment of Polycythemia Rubra Vera. *Ann. Surg.* 1945, 122: 998.

By means of protriocceptor depressor neurotomy, a form of absolute polycythemia has been produced experimentally in dogs. This form of experimental polycythemia disappeared following extensive paravertebral sympathectomy. Support is thus given to the theory that the normal, and some abnormal formation of red blood cells by the bone marrow is under the control of the sympathetic nervous system through its regulation of the caliber of the pre-sinusoidal vessels of the marrow.

The theory is advanced that some cases of polycythemia rubra vera in man are due to constriction of the pre-sinusoidal blood vessels of the bone marrow and extensive paravertebral sympathectomy is proposed as treatment for this disease. The successful result of treatment of 1 man with polycythemia rubra vera by extensive paravertebral sympathectomy is then reported.

SAMUEL KATZ, M.D.

Tyson, M. C., Vogel, P. and Rosenthal, N.: The Value of Penicillin in the Treatment of Aggranulocytosis Caused by Thioracil. *Blood, J. Hemat.*, 1946, 1: 53.

Since 1943 when Atwood found that thioracil effectively inhibited the function of the thyroid gland, this drug has come into increasing favor in the clinical treatment of hyperthyroidism. In severe hyperthyroidism this agent reduces the basal metabolic rate and brings about clinical improvement. Of all the thyroid depressing drugs thus far tested, thioracil seems to be the least toxic. However, sufficient cases have been reported to demonstrate convincingly that thioracil may affect the bone marrow in such a manner as to induce a severe or even fatal aggranulocytosis. During his preliminary experiments, Atwood noted 1 patient who had been given a relatively large dose of thioracil and developed aggranulocytosis. This complication has been observed with varying frequency in later series of cases.

The present authors believe that the use of thioracil is more dangerous than a survey of the literature would indicate. Of 54 cases treated with the drug at Mount Sinai Hospital, New York, 6 (approximately 11 per cent) developed aggranulocytosis. Three additional cases of postthioracil aggranulocytosis came under the care of the authors. In spite of treatment, 4 of the 9 cases studied were fatal. 5 patients recovered after penicillin therapy. Since penicillin has no deleterious effect on the bone marrow, the authors believe that it is ideal for all cases of aggranulocytosis and especially for those that may have resulted from chemotherapy with thioracil, sulfonamide, aminopyrine, or other drugs.

This article calls attention to a number of important concepts that may be summarized as follows:

1 The cases that developed aggranulocytosis had received thioracil for at least 5 to 6 weeks before symptoms of the complication appeared.

2 In the treatment of aggranulocytosis, penicillin is apparently effective in so far as it combats the bacterial invasion and toxemia, and enables the patient to survive until the bone marrow has regenerated.

3 In attempting to explain why some patients develop sensitivity to the drug and others do not, it is suggested that the cumulative effect of the drug may cause sensitivity and subsequent toxic action on the myeloid elements of the bone marrow.

4. While there is no question that under certain conditions thioracil is an excellent drug to tide a patient over an acute episode of thyrotoxicosis, and especially in preparation for thyroidectomy its effectiveness is present only during its administration. It cannot be considered as a medical cure, since it does not affect the basic difficulty of thyrotoxicosis."

MISCELLANEOUS

5. One can predict that in the future there will be an increasing number of cases of agranulocytosis since additional courses of the drug will be an opportunity for more patients to be sensitized to the recurrence takes place and there will thus be an opportunity for more patients to be sensitized to the drug. For this reason it would seem advisable at present to limit the use of the drug only to selected preoperative cases and those in which operation is contraindicated.

DAVID H. LYNN M.D.

Kilne, B. E. Miller J. A., Rusch H. P. and Baumann C. A.: The Carcinogenicity of p-Dimethylaminobenzene in Diets Containing the Fatty Acids of Hydrogenated Coconut Oil or of Corn Oil. *Cancer Res.* 1946 6:1

Ten groups of rats each were fed various lipids in synthetic diets containing 0.06 per cent of p-dimethylaminobenzene for 4 months and these diets were then followed by a dye-free diet for 2 more months.

When 2.4 per cent of lauric acid or 4.7 per cent of the fatty acids of hydrogenated coconut oil were fed, no liver tumors developed within 6 months. If, however, these lipids were replaced by 5 per cent of corn oil, or by 4.8 per cent of the fatty acids of corn oil, the tumor incidence at 6 months was 80 and 53 per cent respectively.

The presence of 5 per cent of olive oil or 4.5 per cent of oleic acid in the diet resulted in a tumor incidence of from 33 to 53 per cent, and 87 per cent, respectively at 6 months. Twenty per cent of the rats fed on a diet free of added fats developed hepaticomas within this time.

SAWART KATZ M.D.

Sugarbaker E. D. The Surgical Problem of Cancer in the Lymph Nodes. *Surgery* 1945 18:668.

This article deals with the problem of the treatment of cancer in the lymph nodes in an attempt to determine how such treatment may be developed to maximum advantage. Considerable divergence of opinion prevails concerning the ideal plan of treatment of occult cancer in the lymph nodes. There is no doubt that the lymph node is an important character of the nodes indicates lymph node involvement. Prophylactic dissection implies that the nodes are suspected of containing carcinoma cells despite the absence of physical signs of node involvement. It is apparent that in both instances errors in diagnosis will occur. There is a wide variation in the frequency with which different sites of primary tumor involve the lymph nodes. Different sites of primary tumor involve the lymph nodes differently, the lymphatic systems of the parts, the size of the lesion, whether the tumor is primary or recurrent, the nature of previous treatment, and the duration of symptoms must all be taken into consideration. The node incidence in some of the commoner tumors is given in Table I.

Another consideration not discussed in the literature but which seems to be pertinent to the problem relates to quantitative node involvement in dissection specimens from the various tumors and the

TABLE I THE NODE INCIDENCE OF CANCER

Tumor	Per Cent
Cardioma, intrinsic larynx	10
Carcinoma, skin	15 to 15
Carcinoma, penis	25
Carcinoma, lip	31
Carcinoma, lower gingiva	35
Carcinoma, buccal mucosa	40
Carcinoma, vulva	46
Carcinoma, tongue and floor of mouth	63
Melanoma, skin	64
Carcinoma, rectum	68
Carcinoma, colon	70
Carcinoma, extrinsic larynx	70
Carcinoma, stomach	75
Carcinoma, breast	75
Carcinoma, tonsil	77
Carcinoma, nasopharynx	80

relative frequency with which widespread metastases occur. A table showing the average number of nodes involved for different types of cases and the per cent of cases with more than one node involved is presented in the original article. It seems reasonable that if a given tumor metastasizes with regularity to only one or two nodes, remains confined there after all clinical doubt as to its presence has been dispelled and very rarely kills by reason of more widespread dissemination, then such a tumor might as well be treated by a dissection done there peccatically instead of prophylactically. Conversely, when a tumor metastasizes regularly to the local nodes before its presence becomes clinically apparent, it is found to involve numerous nodes of the specimens examined and not infrequently brings about death by distant spread, dissection must be carried out prophylactically if it is to be of any use at all. Therefore it is apparent that the problem is concerned not only with how frequently regional nodes are involved but also with how rapidly the disease is apt to spread beyond the limits of the removable chain.

In many instances the anatomy is so adaptable that removal of the primary tumor with the regional nodes becomes little more of a task than removal of the primary tumor alone. This is true of the stomach, bowel, and lungs. The question of node dissection therefore pertains mainly to those tumors in which the primary and node area are best treated separately either at one sitting or in stages. Consideration must be given to the relative value of the several major dissections—cervical, axillary and inguinal—based on the anatomy peculiar to each and the way they tend themselves to node dissection. One must also consider the added risk of prophylactic node dissection in poor risk patients in the cancer age group.

In the surgery of cancer there are in general, two major problems (1) the degree of radicality required by the tumor and (2) the degree of radicality which the patient will withstand. Overestimation of the first and underestimation of the second will result in too high a percentage of postoperative fatalities.

The converse will result in too low a percentage of cured cases. Contraindications to therapeutic and prophylactic needle section are presented as well as the arguments for and against prophylactic dissection in cancer of the lip.

JOHN L. LINDGREN, M.D.

GENERAL BACTERIAL, PROTOZOAN AND PARASITIC INFECTIONS

Epidemiology Unit Number 22 Sulfadiazine Prophylaxis and Resistant Streptococci *J Am Med Ass* 1945 129 921

A previous article has described the pronounced reduction of streptococcal disease which occurred at a large naval training center in the Northwest as the result of sulfadiazine prophylaxis. The present report deals with the loss of effectiveness of this prophylaxis due to the appearance of sulfadiazine resistant strains.

After approximately 3 months of successful sulfadiazine prophylaxis the effectiveness of this large naval training center the effectiveness of this prophylaxis became progressively less and eventually a major epidemic of streptococcal disease occurred. An increase in dosage to as high as 3 gm. daily did not prevent streptococcal diseases and it was the impression of medical officers at the center that the drug had lost its value therapeutically in these infections.

The loss of prophylactic value of sulfadiazine was originally associated with an absolute and relative increase in the frequency of group A type 10 infections to the practical exclusion of all other types. Later group A type 17 became relatively frequent. These two types were shown by laboratory methods to be sulfonamide resistant *in vitro*.

Other types of streptococci with a few exceptions of type 3 were not sulfonamide resistant.

The proportion of sulfadiazine resistant strains was greater in those recruit camps getting sulfadiazine prophylaxis than in those not getting sulfadiazine.

There was some suggestive evidence but no definite proof that in the presence of sulfadiazine resistant strains sulfadiazine prophylaxis tended to increase the streptococcal infections, particularly scarlet fever.

JOHN F. KIRKPATRICK, M.D.

DUCTLESS GLANDS

Shibley, E. G. and Ransfield, A. N.: Glucose Tolerance in Rats following Repeated Small Doses of Alloxan. *Endocrinology* 1945 37 373

This article deals with purely laboratory research of glucose tolerance in rats with repeated small doses of alloxan. It has been shown conclusively that a single injection of a large dose of alloxan (from 200 to 400 mgm/kgm) administered subcutaneously produced severe and permanent diabetes in rats with necrosis of the beta cells in the pancreatic islet (Dunn, Sheehan and McLetchie 1933; Golner and

Gomori 1935). Single intravenous injections of from 60 to 75 mgm/kgm produced equally severe diabetes in rats (Shibley and Meyer unpublished data).

The effect of small repeated doses of alloxan on the functional capacity of the islet is not yet certain. The authors quote the literature on this particular phase of this research and claim that give their procedure of injecting small doses of alloxan in definite control groups of rats. They then discuss their results and give tables showing the results. They have reached the following conclusions:

Rats given 15 subdiabetogenic doses of alloxan over a period of 4 weeks did not become hyperglycemic on a normal diet but showed impaired tolerance to administered glucose.

The decrease in tolerance to glucose appeared to be permanent since it remained 1 to 2 1/2 weeks after cessation of the alloxan treatment.

In a second group of rats there was a marked progressive decrease in glucose tolerance after each injection of a 25 mgm/kgm dose of alloxan. The decrease in glucose tolerance was shown by the higher blood glucose levels reached early in the test and in the slower return of the glucose level to normal.

It was concluded that 25 mgm/kgm doses of alloxan given intravenously produced a progressive damage to the pancreatic islets in rat and that even a small amount of damage was not followed by compensatory reaction.

Extract from the anterior pituitary tube administered to 4 rats with impaired glucose tolerance produced hyperglycemia after 11 days in 3 of the animals.

PETER MARRAS, M.D.

Ungar, G.: Endocrine Function of the Spleen and Its Participation in the Pituitary-Adrenal Response to Stress. *Endocrinology* 1945 37 3

As a part of the problem of the spleen as an endocrine organ has been suspected for a long time. Extensive reviews of the problem by Landis (1931) and by Perla and Marmorstein in 1935 showed, however, that in spite of a great deal of circumstantial evidence there was no solid proof of an internal secretion of the spleen. The last 10 years or so seem to have brought forward any solid evidence it may be a matter that the first experimental evidence article can attribute the first experimental evidence that the spleen produces and can release into the circulation a substance acting like a hormone. It also shown that this function of the spleen is under the control of the pituitary gland and that the adrenal cortex. The significance of the internal secretion of the spleen is not yet quite clear but all the data tend to the conclusion that it is produced in case of emergency and its main action is on the protein metabolism.

The author describes his method of attacking this research problem and gives the results of his response to tissue injury hemorrhage, starvation

MISCELLANEOUS

and drug actions. The results of these suggested that under the influence of certain stimuli a reaction took place involving the pituitary, the adrenal cortex and the spleen. The question then was whether the spleen played its part by releasing the active substance or by causing some other reaction. A crude extract of guinea pig spleen in saline solution was prepared and injected subcutaneously in order to study its effect on the bleeding time of guinea pigs. The mode of action of the spleen was studied and found to have the following effects: (1) it reduced the bleeding time (2) it increased the capillary resistance and (3) it inhibited the histamine release from the blood cells. The author summarizes his observations and concludes as follows:

In the course of a study of the pituitary-adrenal reaction to stress this response was found to be inhibited by splenectomy. It was also observed that spleen extracts contain an active substance which can reproduce the reaction to the original stimulus. This active substance was isolated and obtained in pure crystalline form. It is probably part of the antihemolytic system which protects proteins against trypsin. The spleen as an endocrine organ may therefore play a part in the control of protein metabolism and its adjustment to conditions of stress.

PATL MERRILL M.D.

SURGICAL PATHOLOGY AND DIAGNOSIS

Bowden R. E. M. and Gutmann E. The Clinical Value of Muscle Biopsies. *Lancet* Lond 1945 349 768

The authors note that there are several medical and surgical conditions in which examination of biopsy specimens of muscle is helpful or even essential in the establishment of a diagnosis but until recently this method has been largely neglected in the investigation of neuromuscular disorders. In certain cases of paralysis associated with vascular lesions, the value of muscle biopsies has been demonstrated. In peripheral nerve injuries they have yielded information which has been of great assistance in diagnosis, prognosis, and treatment. In paralysis of gradual onset it may sometimes be difficult to determine whether the lesion is primarily neurogenic or myogenic and in such cases even electrical reactions and electromyography sometimes do not give decisive information. Besides giving information about the state of the muscle fibers a muscle biopsy is a form of nerve biopsy in that nerve fibers, empty Schwann tubes or motor end plates are almost always found among the muscle fibers.

The authors state that the purpose of this article is to indicate the value of muscle biopsies in the diagnosis, prognosis, and treatment of neuromuscular disorders. Four types of cases have been investigated: (1) lower motor neurone lesions due to peripheral nerve injuries, (2) lower motor neurone lesions other than peripheral nerve injuries, (3) primary muscular disorders and (4) vascular lesions.

Some illustrative cases are described and summaries given of the indications for performing biopsies, the methods of treating specimens and the findings.

The indications for performing a muscle biopsy may be summarized as follows:

1 To determine the state of muscles in which atrophy is advanced or in which a vascular lesion is suspected and if the latter is found to assess the type and severity of the lesion. Surgical repair of nerves or long continued physical treatment is valuable if the muscles have been irreparably damaged.

2 To aid in the diagnosis of the type of lesion in the nerve and to determine whether satisfactory regeneration is taking place in partial or recovering lesions.

3 To differentiate between paralysis of myogenic origin and disease of the lower motor neurone.

4 There are special indications for the use of biopsies in certain cases of poliomyelitis as detailed by the authors.

A method of muscle biopsy is presented. The histological findings that are found typical of the types of cases that have been investigated and have been reported herewith are described. In their discussions of the effect of vascular lesions of muscle, the authors state that there is still a difference of opinion about the mechanism underlying vascular lesions of muscle, but from experimental and clinical observations it is evident that two main types of lesions must be recognized: (1) those due to interruption of the arterial supply and (2) those following venous obstruction. A sudden complete obstruction of the artery will cause necrosis of the muscle fibers. If the lesion is the result of venous obstruction, the picture is one of dense fibrous tissue proliferation but there is no clear cut boundary of the affected area. Clearly, in either type of lesion there is a poor prospect of recovery if the changes are widespread. Many vascular lesions are complicated by degenerative lesions of the nerve trunks. In such cases the prognosis is much less favorable.

Finally the limitations of muscle biopsy are presented. It is noted that a biopsy specimen is a small sample. Furthermore, a biopsy specimen may contain no nerve elements. Sufficient time must elapse for regeneration of nerve fibers if biopsy is to be used to determine whether this process is progressing satisfactorily. When a nerve lesion is at a high level it may not be justifiable to wait for biopsy before proceeding to direct exploration of the nerve.

HERBERT F. THURSTON M.D.

EXPERIMENTAL SURGERY

Duguid J. P.: The Numbers and Sites of Origin of the Droplets Expelled during Expiratory Activities. *Edinburgh M. J.* 1945 53 385

The number of droplets expelled during normal breathing, strong nasal expiration, laughing, speaking, coughing and sneezing has been estimated by four different methods.

- 1 Counting the colonies on culture plates exposed directly to the droplet spray
- 2 Counting the droplet stain marks on slides exposed directly to the droplet spray. This gives the number of all droplets larger than about 20 microns in diameter
- 3 Counting the colonies on culture plates exposed in the Bourdillon slit sampler. This gives the number of bacteria carrying droplets small enough (with initial diameters under about 100 microns) to remain air borne as droplet nuclei.

4 Counting all microscopically visible droplet nuclei found on oiled slides exposed in the slit sampler the nuclei being colored by dye previously taken into the mouth. This new method gives the numbers of droplets with initial diameters between about 1 and 100 microns and these counts are considerably greater than the counts obtained by any other method. The numbers of droplets originating from the nose and throat were estimated in tests with bacillus prodigiosus inoculated as an indicator on to one of the sites.

No droplets were found to be expelled by normal mouth breathing for a 1 minute period. Normal nose breathing for a 5 minute period sometimes did not produce any droplets, and sometimes produced a few these droplets were found to originate in the nose. A single strong nasal expiration produced from a few to a few hundred droplets some of these were small enough to form droplet nuclei.

Laughing for a one minute period sometimes did not produce any droplets and sometimes produced a few these originated in the faucial region. A few these were produced from a few to a few dozen droplets counting loudly produced from a few dozen to a few hundred these apparently originated in the front of the mouth and were small

enough to form droplet nuclei. Saying 100 K. loudly sometimes produced a few dozen or a few hundred droplets many of these originated in the faucial region, and a few of the faucial droplets were small enough to form droplet nuclei.

A single cough with the mouth kept well open, sometimes did not produce any droplets, but sometimes produced a few dozen or a few hundred. Many of these originated in the faucial region, and a few were small enough to form droplet nuclei. A single cough with the mouth initially closed produced from a few hundred to many thousand droplets these originated in the front of the mouth and were small enough to form droplet nuclei.

A single natural sneeze produced from a few hundred thousand to a few million droplets these apparently originated in the front of the mouth, and were small enough to form droplet nuclei. In most sneezes, between a few and a few thousand droplets were found to originate both from the nose and from the faucial region some of these also were small enough to form droplet nuclei.

Thus, speaking, coughing, and sneezing produce many droplets small enough to remain air borne as droplet nuclei. Nearly all of these small droplets originate in the front of the mouth. The extent of air borne infection which may be produced by the droplet spray of infected persons, therefore, must depend largely upon the frequency with which pathogenic organisms are present in the secretions of the anterior mouth. This frequency does not appear to be great. The hazard of air infection with droplets originating in the nose or throat, where pathogenic organisms are often present in great numbers is limited by the small amount of atomization which is found to take place at these sites.

SAMUEL KANE, M.D.

SURGERY

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A DISCUSSION OF CONTROVERSIAL POINTS IN AMPUTATION SURGERY

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THERE is great difference of opinion between surgeons concerning the various procedures of amputation surgery. Some disagree concerning only minor variations in technique or unimportant matters of personal preference. Others differ in matters of basic importance. In time of war because amputation is frequently necessary after severe injuries from high velocity missiles great experience is gained in this field of surgery.

At Percy Jones General Hospital in the 33 month period from January 1943 to October 1945 the amputation service has cared for 2,783 patients with major amputations. This is a greater number of amputees than was cared for by the entire Medical Department of the United States Army during World War I which produced only 2,635 amputees. These 2,783 patients had a total of 2,988 amputated extremities. The incidence of amputation per patient and the location of the extremities which were lost are presented in Table I.

As a result of this experience many procedures and techniques of amputation surgery which are controversial have been observed. Observation of this group of patients has established that certain methods have a definite value while others give less favorable results.

OPEN CIRCULAR AMPUTATION

In the United States Army Medical Corps the open circular amputation or as it is more commonly and less accurately termed guillotine amputation was mandatory in all instances of amputation for trauma in forward installations. In this type open operation the skin is cut circularly at the lowest level of good tissue and allowed to retract. The fascia is then incised at the line of skin retraction and the superficial muscles are sectioned and allowed to retract. The deeper muscles are then sectioned at the line of retraction of the superficial muscles and allowed to retract. The bone is then cut through at the line of muscle retraction. *The leg is not chopped off as if by a cleaver.* This procedure carried out

TABLE I — AMPUTATIONS IN 2783 PATIENTS

	Cases	Per cent
1. Loss of extremity only	2584	93.0
2. Loss of 2 extremities	194	6.9
3. Loss of 3 extremities	4	0.14
4. Loss of 4 extremities	1	0.03

SITE OF AMPUTATION

	No.	Per cent
Lower extremity — (85%)	7	0.2
Hip disarticulation	249	8.9
1. Above knee	1487	53.5
2. Below knee		49.8
Upper extremity — (15%)		
1. Above elbow	203	7.3
2. Below elbow	243	8.7

correctly produces a potentially inverted cone when traction is applied to the skin but leaves no flaps to trap infection. If the patient is given proper postoperative care the essential of which is traction the stump is usually ready for definitive surgery in 8 weeks. If constant traction is not applied muscles retract and a large section of bone protrudes from the end of the stump (Figs. 1 to 4).

The flap type of open operation in which overhanging duck bill flaps are produced was forbidden in the American Army forward hospitals. The British Army permitted its surgeons to do the so called flap guillotine operation as they deemed it advisable. Many American surgeons both in military and civilian practice have taken exception to the absolute deletion of the flap type operation in forward hospitals and there has been considerable heated debate around this point. It was claimed that it was out of the question to keep traction on the open circular amputation, and that stumps resulting from this type of open operation would arrive in poor condition in the Zone of the Interior. This objection was not valid. In 3 years and in 2 783 patients with 2 988 stumps there were 30 stumps, or 1 per cent, which had not had the proper postoperative care by the time they arrived at this Midwestern hospital. Many of these patients arrived at the Zone of Interior hospital with effective traction still on the stump having crossed half of Europe the Atlantic or Pacific Ocean and half of this country with very ingenious combinations of adhesive tape plaster and elastic bands to keep the skin from retracting.

The only valid arguments for the flap type of open operation are (1) time, (2) the avoidance of a second operation. The argument of time is valid in that if the immediate convalescence is not complicated by severe sepsis, early secondary closure is possible. In some instances after the first 10 days to 2 weeks the flaps can be permitted to fall together and be loosely sutured thus obtaining a closed stump soon after the injury. The second point is not a valid argument in very many instances. A high percentage of amputation stumps resulting from the secondary closure of inaccurately cut flaps will be poor stumps, with

too much redundant skin and muscle at their ends. This condition will require a late secondary operative procedure to produce the ideal stump. A young vigorous man is going to and must, use his prosthesis hard. He cannot get by with a poorly tailored stump. For the aged individual who will probably use a prosthesis very occasionally and in whom the avoidance of surgical incidents is desirable, the flap type open operation may have added merit. For the young in whom perfection of stump is desired the open circular amputation is believed superior as in this method a late definitive operation is an accepted fact.

In amputations done for trauma, the danger of ever present infection becoming invasive and virulent is reduced to an absolute minimum by the perfect drainage afforded by the open circular operation. The definitive surgery to complete the closure of an open circular amputation is in effect a late secondary wound closure. Whether it be accomplished by plastic closure or by reamputation at site of election it is associated with very little danger. In carrying out the definitive or final operation in 2 988 stumps in 2 783 patients who had had an open circular amputation a severe recrudescence of infection in the amputated extremity as manifested by cellulitis, abscess, high febrile reaction and general sepsis, occurred in only 20 instances, or 0.66 per cent. No patient died as a result of the definitive surgery on the guillotine stump.

Five per cent of patients had some complication of their final surgery. The common complications were a mildly infected hematoma in the stump without systemic reaction or a marginal skin necrosis which required a minor skin plastic later. Most of the patients with the complication of hematoma on its evacuation after the removal of a few stitches recovered with a satisfactory stump and without further surgery.

The severe infections resulting from secondary closure or reamputation occurred many times where they were least anticipated. Some were in a stump which had been completely healed for many months or had been covered by a skin graft for many months. Other stumps which had more than a reasonable amount of granulation tissue at their



Fig. 1



Fig. 2



Fig. 3

Fig. 1. Open circular amputation, immediately postoperative.

Fig. 2. Open circular below knee amputation 8 weeks postoperative. Turned back stockinette is for skin traction. As result of continuous traction, this stump is now ready

for final operation. Skin is pulled well down over end of stump which is healed by scar contracture.

Fig. 3. Below knee stump which has not had traction postoperatively. Skin has retracted and 5 centimeters of bone protrudes, which will have to be sacrificed.

end at the time of surgical revision convalesced with no reaction. The only inference to draw from this is that regardless of how nearly normal the condition of previously infected tissues may appear it is never free of bacteria and those bacteria may become rampant at any time.

All patients received for 48 hours prior to surgery either sulfonamides or penicillin systemically. They also received one or the other of these antibiotics for as long postoperatively as was indicated by their general condition or the local condition of the operative site. Sulfadiazine was the sulfonamide used. About 1,800 patients received sulfadiazine and 1,000 penicillin. The patients preferred sulfadiazine to escape being punctured with a needle. One seemed about as effective as the other in this type of surgery and a positive stand for either to the exclusion of the other was impossible. One or the other however should be used. In 500 operations sulfonamides were used topically in the stump. Late in 1943 the topical use of sulfanilamides was discontinued. Since discontinuing the topical use of sulfonamides, the stumps healed better with less reaction and less hematoma.

TECHNIQUE OF AMPUTATION

Opinion differs greatly regarding the actual technical steps of performing an amputation. As one reads surgical treatises on this subject



Fig. 4. Method of applying skin traction to open circular amputation. The stockinette is glued to the skin before patient leaves the operating table and traction is started immediately.



Fig. 5. a, left, Anteroposterior view. b, Lateral view. Good tapered below knee stump. Skin, nonadherent, no bulbous muscle over end, no bony prominences, no superficial neuromas.

the impression cannot be escaped that much has been carried through the years from book to book which does not hold in the light of present physiological and pathological fact.

The surgical technique of amputation should aim to produce a stump which has soft flexible nonadherent skin and which has no redundant muscle. There should result no projecting bony prominences and the neuromas of all nerves should be well covered and not subject to pressure.

In order to avoid adherent skin dissection of the skin flap in the subcutaneous plane must be avoided as much as possible. A certain amount of freeing of the skin to effect a smooth closure is necessary but this rarely needs to exceed 3 centimeters from the skin flap's distal end. As nearly as possible the skin should be left attached to the fascia.

Wherever possible fascia should be closed over the bone end. In many instances of secondary closure this is impossible. Either fascia and skin or skin alone should be the only covering of the bone end. Muscle should never be used to cover the bone end as it results in a redundant unattached sliding mass at the end of the stump which shrinks very slowly and ultimately turns to scarred avascular tissue. All muscle should be coned out at least perpendicular to the bone end and preferably with its periphery slightly proximal to the bone end. Even in the avascular stump the presence of excess muscle in no way aids the skin circulation, as there are no perforating arteries between muscle and skin.

Some controversy exists relative to the treatment of the bone end. Aperiosteal technique has for years been advocated. By this is meant the removal of a cuff of periosteum about the periphery of the end of the bone. The cuff is variously recommended to be a quarter to one half inch in width. This procedure does not seem a logical one as it deprives the underlying bone of a certain amount of blood supply. In the presence of any sepsis it will in a high percentage of patients, result in a ring sequestrum. The procedure is therefore contraindicated in any secondary closure or secondary reamputation, or in any patient in whom there is any chance of an infected hematoma. Even in the absence of all infection in some instances a ring sequestrum will form because of the avascular necrosis of the bone end, which has been deprived of periosteum.

The periosteum should be incised cleanly at the saw line and at the completion of the bone section the periosteum should be adherent to the end of the bone about its entire circumference. The only reason for the removal of any periosteum from the bone end is that the handling of this membrane has been faulty and rough, thus necessitating the removal of tags stripped loose.

Hemostasis is of utmost importance to the end result of an amputation. Time should be spent tying all small muscle bleeders individually. The development of a moderate hematoma may delay recovery many weeks and even necessitate further surgery. To avoid the collection of blood even after careful hemostasis, it is well to drain the stump with a small rubber drain for 48 hours. Many amputations are done under spinal anesthesia, and a reduced blood pressure may lead the surgeon to a false evaluation of hemostasis. It is well to know the patient's arterial tension before the wound is closed and if it is 20 to 30 millimeters below his preoperative pressure, to have it raised to normal by an injection of ephedrine before the flaps are closed. This will often make what appeared a dry field bleed profusely.

No point in surgical technique has caused as much debate as the method of treatment of the nerve end. This debate has undoubtedly



Fig. 6.



Fig. 7



Fig. 8.



Fig. 9.

Fig. 6. Technique of below knee amputation, skin not lifted off fascia, tibia tapered with periosteum adherent to end, nerves cut high in fascial plane.

Fig. 7. Technique of below knee amputation, muscle coned out so that only fascia and skin remain to go over bone end.

Fig. 8. Technique of below knee amputation. Fascia closed over end, drain placed beneath fascia, excess skin is removed so that in actual closure, very little skin is separated from fascial layer.

Fig. 9. Technique of below knee amputation. Skin closed without redundancy. Drain in angle of skin closure.

resulted from the distressing sequela of 'phantom limb. Many chemicals have been advocated for injection into the nerve to prevent neuromas. The true honored method of alcohol injection has had a long period of usage. British authorities have in recent years advocated the use of formalin as a neurotoxic injection. A Russian school has advocated the cauterization of the artery of the nerve proximal to its distal end. Duck bill closures have been described. More recently a method of burying the nerve end in the medullary canal of the bone was described (Figs 6 to 9).

It is well established that there is no chemical which will prevent the end of the cut nerve from healing by neuroma formation. I am unable to comment on the Russian method of depriving the tip end of the nerve of blood supply but believe it only places the neuroma more proximally. The recently advised method of burying the nerve ends in the medullary canal of the bone is open to great objection if the nerve crosses a joint in the stump as it could easily lead to a nerve put under traction in many motions of the extremity.

For the past 3 years in the Amputation Service at Percy Jones Hospital none of these methods has been used. In fact little or nothing has been done to the nerves in an amputation stump except to treat them with

respect and to hide their ends. The nerve should not be forcefully stretched so that it can be cut off high and then allowed to retract so that it will return to its normal length. Rather the nerve trunk should be dissected and cut off high so that the neuroma which will inevitably result in the natural healing of the nerve end is well recessed in muscle. If a large bleeding vessel is present in the nerve this should be ligated.

PHANTOM LIMB SYNDROME

In 2 988 amputations there have occurred 15 neuromas which required surgical removal and these could probably have been avoided had the surgeon been a little more thorough in the original operation. The only indication for the surgical removal of a neuroma is a superficial location which would cause it to be subjected to pressure thus producing pain. This pressure may come either from the prosthesis or as a result of the bare stump resting on or striking a hard surface and can be demonstrated by palpating and tapping the neuroma, which will produce a shock like sensation. The removal of neuromas for the treatment of any phase of the 'painful phantom limb syndrome' will result in failure.

In this group of 2 783 patients 4 instances of painful phantom limb syndrome have

occurred. Undoubtedly more instances of this distressing complication will occur in this group of patients as the years go on. A certain degree of phantom limb sensation seems to be almost physiological and this fact should be appreciated.

Every individual with an amputation has a phantom limb. Rarely does an individual with an amputation have a 'painful phantom limb'. This phantom sensation has a fairly uniform life history. It is present as a complaint in the days immediately following amputation and is usually more severe when the amputation has resulted from crushing trauma or is accompanied by great suppuration.

As healing progresses and inflammation and induration recede the patient complains less of the phantom pain. He will tell you that he has the foot or hand but that it does not bother him. After the phantom has lessened and the patient has learned to live with it, any surgical procedure on the stump will aggravate the phantom phenomenon temporarily. This fact is true even though the surgical procedure in no way involves the nerve end. In many instances a simple excision of a skin scar in this group of patients resulted in an exacerbation of phantom pains. As healing again ensued the disagreeable aspect of the phantom subsided.

When the patient puts on a prosthesis and uses it successfully the phantom phenomenon rapidly assumes a less prominent place in his scheme of life. In fact many patients will proffer the information that the phantom is a help to them. It gives them some inkling of where their foot or hand is and what position it is assuming. This is the ordinary history of the phantom phenomenon.

The rare individual with the abnormal persistent 'painful phantom limb' must be distinguished from the common group who have the normal residual. Although rare this type of patient is not hard to distinguish. Many times the distinction can be made by the patient's scars. Too often such a patient presents scars of removal of neuromas and section of nerve trunks at various levels in the stump. At the base of the extremity the scar of a surgical attack on the sympathetic

nervous system may be present. In addition to these scars he may also present the pigmented marks of the morphine needle. The cure of a truly painful phantom limb by any surgery is extremely dubious. Certainly there is no basis for excision of neuromas or peripheral nerve section in the treatment of this complication of amputation and sympathetic interruption does not have any great number of successes to recommend it. Whether the newly advised operations attacking the cerebral cortex will prove of value is not known.

Probably the only successful treatment of this problem is its prevention. Unfortunately this cannot always be done by the surgeon as it is impossible for him to control the environment of his patients. However in the early management of an amputee he can use narcotics judiciously and take all surgical measures to reduce and shorten extensive suppuration and tissue necrosis. It is almost universal that the picture of painful phantom limb is associated with the use of morphine or alcohol and with the poor adjustment of an individual to his environment. No surgery devised to date offers a cure for these unfortunates.

The following case history is illustrative of the complex nature of these patients.

A paratrooper lost his right arm in combat. He was a very little individual who had a great record for valor. His arm was knocked off by an 88 millimeter shell and a companion applied a tourniquet. Following this he continued in combat for the next few hours until he was wounded in the thigh.

On admission to a hospital in the United States he was cheerful, hard to keep track of and was all over the building. He had no complaints about his arm. He always seemed to enjoy talking about combat and his personal exploits. His amputation stump was revised and he was fitted with an artificial limb, which he used with great dexterity despite a very short stump.

After using his prosthesis for about 6 weeks he announced that he was returning to duty with the paratroops. This was most unusual but it seemed that while on vacation from the hospital he had gone to a paratroop base where he contacted some commanding officer who asked for his return to duty. While on this leave he had also made some jumps.

Two months after leaving the hospital for duty he returned complaining bitterly and constantly that the fingers of his hand were clenched in the palm and that the nails were cutting the flesh and burning like fire. He could not sleep and paced the floor the



Fig. 10.

Fig. 10. Roentgenogram of tendoplasty thigh amputation. Patella has been removed and quadriceps tendon has been turned over the end of the femur. The periosteum was left adherent to the distal end of bone. No spur



Fig. 11.

Foreign bodies were not removed.

Fig. 11. X-ray of Gritti-Stokes stump in which patella has lost anchorage to femur and there is osteomyelitis of patella and femur.

typical picture of the painful phantom limb syndrome.

On questioning this patient about the onset of the trouble he related the following story. After going to duty he did well and had no trouble. He had joined a paratroop battalion. After training with them he had finally talked his superior officers into sending him overseas again with the combatants. He arrived at the Port of Embarkation. Here he was given a medical examination. The examining medical officer put his hand on the prosthesis and as he did so said, "You can't go overseas with a wooden arm." The patient amputee said that at that instant he became infuriated that the fingers of his amputated extremity dug into the palm of the absent hand with excruciating pain and that if his arm had been his own he would have slugged the damn doctor. This pain pattern had persisted since this disappointment.

This patient insisted his pains were due to palpable neuromas in the stump. At his insistence and with great skepticism these neuromas were removed. His complaints continued unabated. Then one day about 2 months after the removal of the neuromas out of clear sky he came to the Medical Officer in the ward with a telegram in his hand and announced that he was cured. He stated emphatically that he had no discomfort in his stump and no phantom sensation. To demonstrate his recovery he waved his prosthesis around and lifted a table off the floor with it. It had been impossible prior to this to get the patient to wear the prosthesis. The telegram which he had received was an order from a relief organization for him to go overseas for duty with them in the Zone of Activity.

This case history is well worth remembering. It does not infer that knowledge concerning the painful phantom limb syn-

drome is complete and that there may not come in the future some organic approach to this distressing problem. At present, however, the painful phantom limb syndrome should be listed as a condition not relieved by surgical treatment. A careful analysis of all these patients will reveal one or all of the following factors to play a prominent rôle: viz. drugs, alcohol or severe maladjustment and frustration.

SKIN GRAFTS IN AMPUTATIONS

There has been some advocacy of the use of split skin grafts to hasten healing of open amputations and also of the use of pedicle grafts to conserve length in a short stump. No type of skin graft will stand the wear of a prosthesis and under no circumstances is even a pedicle graft a justifiable final procedure in the lower extremity. There may be rare instances in the upper extremity in which a pedicle graft will preserve valuable length. In the arm the wear and tear from the prosthesis is not so great and the circulation of the stump is usually superior to the lower extremity.

Split grafts have been advocated to produce early healing of open amputations and shorten the time of invalidism. Split grafts can be successfully applied early to open amputation stumps. However, if these stumps are given the proper postoperative attention by keeping



Fig. 2.



Fig. 3.



a



b

Fig. 14.

Fig. 2. Skin incision for Syme amputation.
Fig. 3. Disarticulating ankle from inside out in Syme amputation. The os calcis is being shelled out subperiosteally to prevent damage to blood supply of heel flap.

Fig. 14. Syme amputation. Section of tibia and fibula centimeter proximal to articular surface of tibia. Section at this low level preserves flare of ankle joint. a, Saw is cut. b, Articular surface being removed.

traction applied a split graft is not necessary. The use of split skin grafts to produce early healing does not make the final surgery for an open amputation easier but more difficult. The normal skin rather than coming over the end, as it does with traction, recedes to the margin of the skin graft. Consequently when the final surgery is done there is a paucity of normal skin and the result is that useful bone length must be sacrificed. If a severely traumatized or burned extremity has extensive skin loss and there is much loss of plasma early grafting may be the only means of restoring protein balance. Skin grafting of stumps for other than this reason is rather useless surgery. If for any reason skin grafts are to be used the donor site should not be any place on the extremity which is expected to use a prosthesis as too often painful irritable keloids result at the donor site which later interfere with the wearing of a prosthesis.

END-BEARING STUMPS

There is considerable disagreement in opinion regarding the ideal thigh stump. These differences of opinion are almost on the basis of nationalism. The British take the stand that no amputation stump is suitable for bearing weight on its end, and that end-bearing stumps will not stand up over a long period of time. They fit all lower limb prostheses even for a below the knee amputation so that weight is borne on the ischial tuberosity.

The general consensus of American surgeons is that an end-bearing thigh stump is

the best thigh stump possible. Certain Canadian surgeons are staunch advocates of end-bearing stumps and are great enthusiasts about the Griggs Stokes thigh amputation in which the patella is attached to the sectioned femur for the weight-bearing end. They are also great champions of the Syme amputation, an end-bearing tibial stump. The British quite stalwartly condemn both the Griggs Stokes and the Syme amputation.

Our experience makes us feel that an end-bearing thigh stump is the desirable type of thigh amputation to obtain when possible in an individual under forty. We have seen this type stump stand up under the most vigorous usage that can be given them and we feel that the patient walks with a more secure and better gait. We are not greatly enthusiastic about the Griggs Stokes type of end-bearing stump. The reason for this is that despite the best of technique in carrying out the operation the patella will in a certain number of instances, slide off the end of the femur resulting in an unsatisfactory stump. Its scope of application is also very restricted. Where there is any chance of even the mildest sepsis, complications are likely to be very time consuming. It is an osteoplastic operation, which to be successful requires the patella to unite by bone to the end of the femur just as any fracture heals. Even a mild infection may result in a failure of union of the patella to the femur or in an osteomyelitis of both the patella and femur. Because of potentially infected tissue the Griggs-Stokes type of amputation is not often applicable to the re-



Fig. 15.

Fig. 16

a

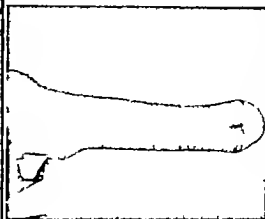


Fig. 17

b

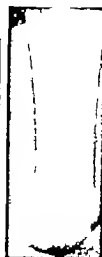


Fig. 18

Fig. 15. Syme stump closed, drain in angle of incision for 72 hours.

Fig. 16. Syme amputation. Cruciate straps of sterile flannel glued to skin, immediately postoperative to prevent displacement of heel pad from center of stump.

Fig. 17. Good Syme stump. Weight bearing heel pad is centered under tibia, with neither varus nor valgus deviation. a Anteroposterior view b Lateral view.

Fig. 18. Poor Syme stump. The heel pad has slipped to tibial side of stump.

amputation or closure of open amputations that have been done for trauma. In addition the tendoplastic type of end bearing thigh stump in which the patella is removed and the quadriceps tendon turned over the end of the femur produces an end bearing thigh stump which is just as good as the Gritti Stokes stump (Figs 10 and 11).

The Syme amputation has never been very popular in this country. It has had a lukewarm reception for the following reasons. Until the last few years it has been difficult to obtain a satisfactory prosthesis for this stump and American leg makers were not interested in supplying one. The Canadian limb makers have developed an excellent prosthesis for the Syme stump which is now universally available in the United States. Being unfamiliar with this operation American surgeons have had too many failures due to necrosis of the skin flaps and to a misalignment of the heel pad.

The operative technique and the post operative care of this stump are more exacting than in any type of amputation. The blood supply of the heel flap comes almost completely from the medial side through a branch of the posterior tibial artery. If the operation is done from the inside out by disarticulating the ankle through the anterior portion of the incision and the os calcis is removed sub

periosteally the blood supply to the heel flap is never endangered and the chances of skin necrosis are obviated. If the foot is removed from the outside inward and the skin fat flap of the heel is taken off the os calcis extra

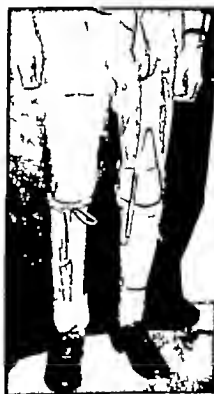


Fig. 19. Prosthesis on Syme stump (right leg). No corset above knee. The patient has below knee amputation of left leg which requires corset on thigh.



Fig. 30.

a

Fig. 31.

b

Fig. 30. Chopart foot stump. The anterior dorsiflexor muscle group have no attachment to tarsus. The remains of the foot is fixed in extreme equinus which is an unusable position.

Fig. 31. Short below knee stump projects 3 inches below thigh with knee flexed. Very valuable to patient in motivating prosthesis. Stump of this length should be saved. a, Anteroposterior view b, Lateral view

perosteally the blood supply of the flap will be cut off in a considerable number of instances.

There is a tendency for the heel flap to slide to the inside of the stump or to assume a varus position so that the pad of the heel is to the end of the tibia, like a side car on a motor cycle, and this, of course produces a useless stump. This sliding of the heel flap is very easily avoided by maintaining it in place over the end of the tibia with adhesive straps which are changed at intervals for a period of 4 weeks. At the end of this time the pad is well stuck to the tibia and there is no further danger of medial displacement.

For a male the Syme amputation is the best possible amputation stump in the lower limb. It has the advantage that the prosthesis does not extend above the knee. In the prosthesis the patient can walk and stand longer than with any other type of leg amputation and it is possible for a patient to walk with a gait that is so close to the normal that the public will not know he is an amputee. In addition to these facts even without the prosthesis the patient need not use crutches or hop. Because of the length of the stump and because it is end bearing he can walk about the house at night on the end of the stump or when swimming or golfing he can get around to the shower and bath without having to carry crutches with him (Figs 12 to 19).

The Syme amputation is not a good amputation for a woman. The prosthesis for this

amputation is bulky and unsightly at the ankle. From a cosmetic viewpoint, it is probable that women would not be happy with this type of amputation despite its superiority of function.

The British objection that this amputation will not stand wear and tear is without foundation. In Toronto there are many patients with a Syme stump who have been at work on the stump every day during the 25 years which have elapsed between wars. We have also used this type of amputation in some 60 patients and they are doing well. It has been used whenever possible in all Army Amputation Centers during the present war and the American surgeon will become more acquainted with its value.

AMPUTATIONS THROUGH FOOT

Many types of amputation preserving the tarsal bones are described among which is the Chopart amputation. These types of amputations are frequently tried because of the fact that they preserve the ankle joint. The Chopart amputation is doomed to failure and should not be done if the muscles on the front of the leg have lost their attachment to the stump of the foot. This is simple to determine. If these muscles have an attachment to the foot the patient can dorsiflex the foot stump. When the attachment of these muscles to the tarsus can be preserved the Chopart or any amputation through the foot should be done in preference to a higher amputation as the



Fig. 22. Arm amputation stumps of no functional value. (a) Described in text. (b) Through surgical neck of humerus. (c) At pectoral insertion. (Courtesy of J. B. S. G.)

individual will be less handicapped. This of course does not apply to amputations done for arterial disease.

In instances where the anterior muscle attachments to the foot the anterior tibial cannot be preserved the foot stump will gradually and inevitably assume a fixed equinus position due to the unopposed action of the gastrocnemius soleus muscle group and the foot stump in this position will be a handicap rather than a benefit. In instances where this muscle imbalance cannot be prevented a Syme amputation is preferable to the deformed remains of the foot (Fig. 20).

SHORT BELOW KNEE STUMP

A question which often faces the surgeon is how short a below the knee stump is useful and should be preserved. Or to put it another way, How much of the leg must remain before an amputation is done through the femur and the knee discarded? A good rule to follow is that any length of stump which can be seen to project when the knee is flexed should be saved. A stump which projects as little as 1 inch with the knee flexed is of value to the patient as a motor for moving the prosthesis through the normal knee. Although a patient with such an abbreviated below the knee stump will have to wear the same type of prosthesis as an above the knee amputee, he will use the prosthesis better and will have greater security and control in going down

incline. A patient with a stump which projects 2 inches below the thigh when the knee is flexed will be able to do well with the ordinary below the knee prosthesis and will not need an ischial bearing prosthesis. An occasional leg maker will depreciate these short below the knee stump because they are difficult to fit, but the knee should never be sacrificed in an individual who has good circulation if the stump can be seen to project when the tibia is flexed to a right angle on the femur (Fig. 21).

UPPER EXTREMITY AMPUTATIONS

Amputations of the upper extremity are not common in civilian practice and it is therefore rare that a civilian surgeon has much experience in dealing with the problems of these individuals. The general attitude of surgeons toward amputations of the arm is



Fig. 23. Photograph of stenture harness required to keep prosthesis in place on amputation from just below the shoulder. (Courtesy of J. B. S. G.)



Fig. 24.

b

Fig. 25

Fig. 24. a, Idea upper arm stump. b, Prosthesis on upper arm stump. Dotted area is space required for elbow block and mechanism. (Courtesy *J Bone Surg*)

Fig. 25. Prosthesis for an above elbow stump. Dark triangular area contains lock which patient must manipulate with other hand to obtain different degrees of flexion and extension. (Courtesy *J Bone Surg*)

to save all possible. This is a good attitude but it can be elaborated a little further as some arm stumps are more satisfactory than others.

No amputation through the humerus above the level of the humeral insertion of the pectoralis major produces a stump which has any functional value worthy of consideration. This fact does not mean that the head of the humerus should be removed unnecessarily as it tends to round out the shoulder and from a cosmetic viewpoint is desirable. Even though an inch or two of the humerus remains, if the pectoral attachment has been lost the end of the short piece of bone is pulled by the rotators into abduction and forward flexion. Amputations just below the pectoral attachment also produce stumps of little value in motivating a prosthesis. At this level the remainder of the humerus stays opposed to the thoracic wall and just a little forward and backward motion of the stump is possible. This movement is practically valueless in using an artificial arm. To maintain a prosthesis in place on these high amputations, an elaborate uncomfortable harness is necessary. Because of the uncomfortable harness, the weight of the prosthesis, and the uselessness of the artificial extremity most patients ultimately discard the mechanical extremity and go about with an empty coat sleeve (Figs. 22 and 23).

The best site for an amputation through the humerus to secure the bone length adapted to the most efficient use of a prosthesis is the level just above the beginning of the flare of the condyles of the humerus. At this site 2 to 3 inches of bone above the elbow are removed. Amputation here is superior to a disarticulation through the elbow as it allows room for the mechanism of the elbow block, without placing the elbow at a lower level than the remaining arm and thus making a disproportionate forearm. The absence of the condyles and the loss of the distal 2 to 3 inches of the humerus do not detract enough from the functional value of the humeral lever to offset the cosmetic and mechanical difficulties in the prosthesis (Fig. 24).

The importance of saving the elbow joint when possible cannot be too greatly stressed. The functional value of the elbow to the upper extremity is even greater than that of the knee to the lower extremity. Without an elbow joint under voluntary control, the arm amputee is limited to a few positions of the forearm, under the control of a mechanical lock which he must unlock with the other hand to release. In close quarters, even with the ideal humeral stump he may have to place the forearm of the prosthesis in one of a few positions available with the other hand. Even a relatively short stump of the forearm

will obviate this difficulty to a large degree. The short stump of the forearm need contain only a piece of the ulna and the necessity for removing the proximal end of the radius does not interfere with active flexion of the elbow since the brachialis muscle attaches to the ulna. An elbow joint is of great value even though it does not have total motion. A flail elbow joint is also of value. The condition of the humerus above the joint does not have to be normal to make the elbow worth saving. As the arm is not a weight bearing extremity a fibrous union of the humerus may suffice for excellent use of the forearm stump since the corset of the prosthesis will stabilize the humerus, as the sidebars will stabilize a flail joint at the elbow. No unnecessary reconstruction which through long immobilization might lead to stiffness of the elbow should be proposed when it will jeopardize function (Figs. 25 and 26).

The ideal forearm stump is one through the junction of the middle and lower thirds of the forearm. This level provides enough bone length for a firm grip on the cuff of the prosthesis by the stump and permits 2 to 3 inches of the volar surface of the forearm below the elbow to be unencumbered by the prosthesis cuff. This eliminates interference with flexion of the elbow caused by the cuff pinching and impinging on the front of the arm. This level is also just above the site at which the forearm becomes largely tendinous and avascular. Such a stump has an excellent blood supply, is warm and will tolerate well the rubbing of a prosthesis cuff. Forearm stumps shorter than this are very useful but, as the distance between the end of the stump and the insertion of the biceps decreases the necessity for covering a greater proportion of the volar surface is increased and flexion of the elbow may be interfered with by the encasement of the prosthesis. In the lower third of the forearm after the muscles have merged with their tendons there is poor circulation as only main arteries traverse this area. Stumps through this area are cold and often cyanotic. Ulceration of skin is not uncommon in stumps in the lower third. The difference in temperature at these two levels can be easily detected by palpation with the hand.

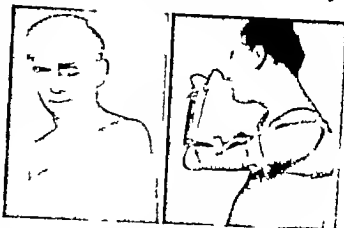
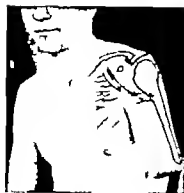


Fig. 25. Short one bone (ulna) below elbow stump.
Fig. 26. Short one bone (ulna) below elbow stump.

Disarticulation through the wrist joint is not a lack of amputation. It has all the disadvantages of a stump in the lower third of the forearm. In addition the inferior radioulnar joint may be very painful on pronation and supination. The loss of its carpal articulation and abutment causes a loss of stability of the joint which produces pain. The prominent ulnar styloid processes represent a major liability in the prosthesis and the stump is likely to be sensitive.

The stump which contains the proximal or proximal and middle wrist carpal bones is however a very useful and satisfactory stump from the functional viewpoint. From the cosmetic aspect it has a few disadvantages. The reason for the superiority of this stump to the disarticulation through the wrist are obvious. First of all it must of necessity be covered by tissue with a good blood supply—as the palmar flap of the heel and upper half of the hand. Second the inferior radioulnar joint is stable and painless because of the presence of its normal abutments and ligamentous support. Third there are no bony unprodded prominences. The length of the stump containing carpal bones together with the slight voluntary flexibility of this distal end make it of considerable aid to the patient without a prosthesis. This stump can be used satisfactorily for a stabilizer in such activities as driving a car, tying shoe laces, tying a necktie, buttoning a coat, etcetera. This stump also requires much less harness to keep the prosthesis in place and to motivate it powerfully (Figs. 27 to 31).



a



b



Fig. 25.

Fig. 24. a, Idea upper arm stump b, Prosthesis on upper arm stump. Dotted area is space required for elbow block and mechanism (Courtesy *J Bone Surg*)

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simple surgical procedure that is not mutilating and it would seem that in certain well selected patients its trial might be justifiable. The skin tunnels can be easily removed with out detracting in any way from the previous value of the stump if they are found unsatisfactory.

PHYSICAL THERAPY IN POSTOPERATIVE CARE

Physical therapy has a definite rôle in the postoperative treatment of the patient who has lost part of an extremity, and this rôle is too often not clearly enough understood by the surgeon. Massage has very little place in returning the stump to its optimum condition. Its only use is to free an adherent scar. Its efficacy in shrinking a stump is of little value and is far surpassed by the use of elastic bandages, properly applied and by the use of a temporary walking prosthesis such as a pylon. The real shrinkage of the stump takes place with activity and weight bearing, and may be so rapid as to make a new leg a profit in a few weeks. Shrinkage should be accounted for to a large degree before the permanent prosthesis is obtained.

The real value of physical medicine in the care of the amputee is in (1) the prevention and relief of contractures and (2) the development of the muscles which will later be used in motivating the prosthesis.

It is a very common thing for an amputee to develop a contracture of a joint in the involved extremity during the preoperative and immediate postoperative period. The joints most commonly involved in the lower extremity are the hip and the knee and in the upper extremity the shoulder.

The flexion contracture of the hip is the most serious detriment to the proper use of a

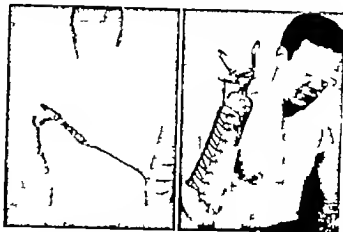


Fig. 31. Prostheses for forearm stump with carpal bones. a, Left. Light harness. b, Powerful control split hook in position. (Courtesy J. Bone Surg.)

prosthesis and is most frequently overlooked. The contracture is due to a shortening of the lateral or abductor muscles of the thigh. With the stump abducted it is not obvious; with the stump adducted it may be very prominent. The deformity makes it necessary for the patient in standing either to bend forward and thus submit to gravity or to arch his back to compensate for the flexion in order that he may hold his head over his feet. The compensation by increasing the lordosis leads to backache and to early arthritic changes in the spine.

The fitting of a prosthesis to an abducted or flexed stump is difficult and the deformity must be compensated for. It is this deformity in the thigh stump which leads to the bucket striking the adductors and pubis and causing great discomfort. In very short thigh stumps the flexion-abduction contracture cannot be obviated and the bucket must be especially constructed to accommodate for it.

In all thigh stumps which preserve half the length of the leg this contracture can be re-



Fig. 32. Cosmetic latex hand on long carpal bone stump. a, Left, Caucasian, cosmetic prosthetic hand on right hand. b, Negro, cosmetic prosthetic hand on left hand. (Courtesy J. Bone Surg.)

ieved by stretching exercises and the development of muscles which prevent it. The development of these contractures can also be obviated by the simple expedient of having the patient lie periodically on the stomach instead of sitting in bed with the hip flexed or propped up on pillows for 24 hours a day.

Flexion contractures of the knee occur frequently in below the knee amputations and when present to over 10 degrees are a serious impediment to walking as the partially flexed knee lets the patient down. They are best prevented and this is easily done by having the patient contract the patella, straightening the knee which also helps to prevent atrophy of the quadriceps muscle. When present they usually yield readily to passive stretching of the hamstring muscles and the capsular structures.

In the upper extremity the frozen shoulder with the humerus bound to the side, is easily prevented by keeping the amputated extremity on an aeroplane splint in 90 degrees of abduction. This is also a very great adjuvant to healing as it obviates the dependent edema and bogginess in the tissues. A contracture of the shoulder will yield just as any adhesive bursitis to passive stretching of the contracted pectoral muscle and active exercise of the deltoid and rotators. No amputated extremity can be expected to use a prosthesis efficiently until all contractures are released.

The efficient use of an artificial leg in an above the knee amputee depends on the full development of the gluteus maximus muscle which extends the hip and the adductor muscles which pull the leg toward the midline. Too often after the invalidism which has accompanied the surgery these muscles are atrophied and weak. Special exercises against resistance to strengthen these muscle groups should be instituted as soon as the stump is healed from surgery. It does not take a masseuse to carry these out and the surgeon who removes the leg should instruct the patient in them and see that he carries them out to the point of good muscular development otherwise he has completed his job no more than has the surgeon who removes an eye and leaves an unsuitable socket for the artificial eye.

The patient with a below the knee stump, in addition to having good musculature to extend and adduct the hip must have good muscles to extend the knee. Exercises to develop the quadriceps femoris should be started early and continued until there is good strength in this muscle group.

The arm amputee must have a good deltoid and if he has an elbow joint must have a good biceps to flex the prosthesis.

SUMMARY

1. The open circular or guillotine amputation is the safest type of procedure in the presence of infection. Proper after-care consisting of skin traction is a requisite to a good result in this type operation. A late secondary operation is necessary as a final procedure. This combination results in a better tailored stump than the open flap type of operation.

2. Fascia and skin or skin alone should be the only covering of an amputation stump. No muscle should be turned over the end of the stump. Aperiosteal technique is neither necessary nor sound. The nerve end should be well recessed under muscle. No chemical treatment of the nerve end is necessary. Complete hemostasis is necessary to good result.

3. Phantom limb is commonplace after amputation. Painful phantom limb syndrome is another thing. Drugs, alcohol, and psychic factors play a great part in the production of the latter. Surgical removal of neuromas does not benefit the established 'painful phantom limb syndrome' and any surgical attack on the syndrome will in almost all instances result not only in failure to cure but aggravation of symptoms.

4. Pedicle grafts are not satisfactory for weight bearing stumps and will not stand the wear of a prosthesis. Skin grafting of open amputations is not necessary if proper after care consisting of traction, is carried out. Skin grafting does not facilitate final surgery.

5. End bearing stumps are desirable in individuals under 40 years. They will stand up over time. The tendoplasty thigh stump is the best end bearing thigh stump. The Syme amputation is the best possible stump in the lower extremity if the foot must be sacrificed.

6 A below the knee stump which projects as little as 1 inch when the knee is flexed should be saved. It is of great help in motivating a prosthesis.

7 Any partial foot stump which has the anterior muscle groups attached should be saved. If the anterior muscle group is not attached a partial foot stump will inevitably go into severe equinus deformity and a Syme amputation is superior.

8 A humeral stump at or above insertion of the pectoralis major has no functional value. Every effort should be made to save the elbow joint even though the stump below

it is very short. Long stumps with the carpal bones in are excellent. Disarticulation through the wrist leaves a poor stump. The best site for forearm amputation is the junction of middle and lower third.

9 Indications for cineplasty are extremely restricted. It should not be considered except in bilateral upper extremity amputees.

10 Physical therapy has a definite place in the preoperative and postoperative care of amputees. Massage is of very little value. The function of physical therapy is to prevent and release joint contractures, and to develop musculature.

CANCER OF THE CERVIX

A New Technique for Interstitial Implantation of Radium into the Parametrium

E. EUGENE COVINGTON M.D., Baltimore, Maryland

A NEW technique has been developed for interstitial implantation of radium into the parametrium and lymph nodes of the pelvis in cancer of the cervix. This is a preliminary report on the first 100 cases. It is not an analysis of 5 year results as some of the patients have been treated less than 5 years. The patients treated so far have all been clinical stages I (3 cases), II (17 cases) and III (80 cases). Interstitial therapy is not justified in stage IV cancer of the cervix.

REASONS FOR A NEW TYPE OF RADIOTHERAPY

The new technique was developed for several reasons chief of which are as follows

1 *Inverse square law* The inability to deliver enough irradiation into the parametrium and lymph nodes of the pelvis by the usual course of roentgen therapy combined with contracervical and intrauterine applications of radium. It should be emphasized that the loss of irradiation due to the inverse square law makes it impossible to concentrate a lethal (10 to 12 erythemas) dose of irradiation into the parametrium and lymph nodes along the lateral wall of the pelvis by the usual contracervical and intrauterine applications of radium. For example, if the true pelvis measures 12 centimeters in its transverse diameter the center of the pelvis (intrauterine canal) is 6 centimeters from the lateral wall. Due to the inverse square law it would take 36 times as much radium (3600 mgm. hrs. of radium) in the cervix to get 100 milligram hours of radium into the lymph nodes along the lateral wall of the pelvis. This amount would be 1 erythema or about one-tenth the amount of irradiation necessary to destroy

cancer cells present in the lymph nodes along the lateral wall of the pelvis. It is thus obvious that some form of interstitial therapy is necessary to concentrate a lethal dose of radium into the parametrium and lymph nodes along the lateral wall of the pelvis.

2 *Local recurrences in the cervix* There have been too many recurrences locally in the cervix and adjacent parametria following the usual amount of irradiation. In numerous clinics an average course of irradiation therapy is about as follows: 2000 r to each of four pelvic fields followed by one application of contracervical and intrauterine radium (3000 to 4500 mgm. hrs. of radium). The author has seen too many positive biopsies after this form of therapy. A two dose technique of radium application, the last being interstitial, is now advocated: thus a greater amount of irradiation can be delivered to the cervix and a much greater amount to the parametria and lymph nodes of the pelvis. Pathologists have observed from autopsy studies a high percentage of deaths from cancer of the cervix with the tumor still localized to the pelvis and no evidence of generalized metastases. About one-third (reports of clinics vary from 20 to 35 per cent) of all deaths from cancer of the cervix are due to urinary obstruction from extension of the tumor into the parametria. Morton noted that almost 50 per cent of the cases of cancer of the cervix had microscopic cancer cells present in the cervix at the time of operation. This high percentage of residual cancer after radium treatment is not general throughout the country but it does strengthen the argument that there are still too many cases in which the cancer still localized to the cervix, has not been eradicated by radium. Taussig and Meigs have found positive glands in the pelvic lymph nodes at operation in

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almost one-third of all early cases (stages I and II) when they were not suspected clinically before operation. Many observers Teahan, Pomeroy, Pitts and Waterman and Arneson dissatisfied with their results in cancer of the cervix with parametrial extension are advocates of interstitial implantation of radium element needles or radon seeds into the parametrium through the vaginal route. It is thus obvious that interstitial therapy is necessary and must accomplish two purposes, a higher total dose of irradiation to the cervix, and a more equal distribution throughout the parametria and lymph nodes of the pelvis of a lethal dose of irradiation.

3 *Trend back to surgery* Within recent years there has been a renewed interest in the Wertheim type of panhysterectomy usually associated with the Taussig type of lymph node dissection for selected cases of early (stages I and II) cancer of the cervix. Many gynecologists now believe the combination of irradiation followed by panhysterectomy will give a higher percentage of 5 year cures than either procedure alone. It is certainly true that a panhysterectomy is a much safer surgical procedure after the gross tumor has been almost entirely destroyed and the secondary infection cleared up by previous irradiation therapy.

Surgeons have three good reasons for their belief in a radical type of panhysterectomy for cancer of the cervix. (1) There are still a few cases in which the cancer of the cervix cannot be controlled by the present-day type of irradiation. (2) About one third (Taussig 33.3 per cent, and Meigs, 17 per cent) of all early cases (stages I and II) will have cancer cells in the pelvic lymph nodes at operation. Irradiation has a delaying effect on such cancers, but a low 5 year cure rate. (3) Improvements in surgical technique especially the modern advances in the control of infections, have so lowered the operative mortality and morbidity that panhysterectomy is a safer procedure than in former years. Panhysterectomy then should offer a better 5 year cure rate in early cases, and it is now up to the radiologists to offer something equal to this definite step for ward obviating the necessity of resorting to major surgery.

TECHNIQUE OF RADIOTHERAPY

The author advocates a new technique for delivering a greater dose of irradiation to the cervix and a much greater dose equally distributed throughout the parametria and lymph nodes along the lateral wall of the pelvis.

First radium treatment As the first treatment 3600 milligram hours of radium with 1 millimeter platinum as a filter was used as follows. One long rubber tandem (90 mgm of radium \times 24 hrs. = 2160 mgm. hrs. of radium) was inserted into the intrauterine canal and a rubber tandem (30 mgm of radium \times 24 hrs. = 720 mgm. hrs. of radium) was packed with gauze as far laterally as possible into either lateral vaginal fornix. This procedure gave a fairly equal distribution of irradiation throughout the pelvis. A serious mistake and probably the most common cause of radiation necrosis is to concentrate a large quantity of radium in a small area usually the contracervical region giving an overdosage and thus necrosis in that small area and not enough throughout the pelvis. Packing the rubber tandems in the vaginal fornices with gauze is better than colpostat technique. There are so many anatomical variations and variations in the amount of cancer present that in many instances the colpostat technique was impractical. Five grams of sulfanilamide was routinely dusted on the cervix before the gauze packing. In the present day of sulfonamides and penicillin to control infections there is no reason to use roentgen therapy first for this purpose.

Roentgen therapy Within a few days (usually 1 to 7) after the first radium treatment roentgen therapy was started which was as follows. 2000 to 2400 r was given to each of four pelvic fields over a period of 4 weeks. The physical factors were 400 kilovolts, Thoreus filter (1.75 mm sn 8 mm. cu and 1 mm. al) 50 centimeters distance, and 15 centimeter cone portals. This technique gave a 42 per cent depth dose (42 per cent of 8000 r = 3360 r in the tumor) into the cervix (10 cm. depth) and adjacent parametria.

New interstitial radium technique As soon as the roentgen therapy was completed (usually 30 to 35 days after the first radium

treatment) the second treatment or interstitial implantation of radium was done. By this time the secondary infection was usually cleared up and most of the gross tumor especially the friable type of cauliflower growth, was almost entirely gone. A search of the literature reveals that no one has used exactly the same interstitial technique of radium as will now be described in detail as the author's technique. Four small incisions (5 cm.) were made in the vaginal mucosa at equidistant points as far laterally from the cervix (usually 2 to 3 cm.) as possible. The incisions were actually in the 2, 4, 8, and 10 o'clock positions around the cervix (Figs. 1, 2, and 3). It should be emphasized that the cutting was only through the vaginal mucosa and not into the parametria. A long Kelly clamp was next used to dissect a long tract (usually 2 to 4 cm.) into the parametrium through each of the four incisions. This dissection is the most dangerous part of the whole procedure but by care, patience and experience the author has now done this new procedure in well over 100 patients with no evidence of injury at operation to a blood vessel, ureter, bladder or rectum in a single case.¹ After dissection of the four tracts as described, four rubber tandems were made up as follows: two tandems contained 25 milligrams of radium, and two tandems contained 20 milligrams of radium (usually 2 tubes of 10 mgm. each). A rubber tandem was then inserted into each of the four tracts. This gave 1260 milligram hours of radium (45 mgm. of radium \times 28 hrs. = 1260 mgm. hrs. of radium) into either parametrium or a total of 2520 milligram hours of interstitial radium. A long rubber tandem (60 mgm. of radium \times 28 hrs. = 1680 mgm. hrs. of radium) was then inserted into the intrauterine canal. Five grams of sulfanilamide was routinely used locally and the vagina was packed with gauze. The gauze packing helps to push the bladder and

TABLE I.—TOTAL IRRADIATION GIVEN IN 100 CASES

	Radium dosage mgm. hrs.	Röntgen dosage mgm. hrs.
First radium in intrauterine canal	1680	
Second radium in intrauterine canal	1680	
Total in intrauterine canal		3360
First radium in right fornix	720	
Second radium in right parametrium	1260	
Total in right fornix and parametrium		1980
First radium in left fornix	720	
Second radium in left parametrium	1260	
Total in left fornix and parametrium		1980
Total radium		7800
Röntgen therapy in cervix and parametria (8000 r. given, depth dose equals 42 per cent at 10 cm. with 400 kv.)		3360

rectum forward and backward respectively away from the radium.

TOTAL RADIATION GIVEN

A glance now at Table I will show that irradiation given over a period of 35 to 40 days, by use of a two dose radium technique, the last being an interstitial application, combined with roentgen therapy as described accomplished two purposes: a high total dose given to the cervix (3360 mgm. hrs. of radium + 3360 r.—42 per cent of 8000 r.—of roentgen therapy) and a high total dose fairly evenly distributed throughout the parametria and lymph nodes of the pelvis (1980 mgm. hrs. of radium + 3360 r. of roentgen therapy to either parametrium). The total irradiation given directly into the tumor is thus 7800 milligram hours of radium + 3360 r. of roentgen therapy.

CONTRAINDICATIONS FOR INTERSTITIAL RADIUM THERAPY

Interstitial implantation of radium was always discontinued for any of the following three conditions:

1. *Radiation fibrosis.* There was an occasional patient, most commonly an elderly woman who would develop so much fibrosis from the first radium treatment and the 8000 r. of roentgen therapy previously given that the

¹This new dissection and implantation of radium technique was done several times in the autopsy room on fresh cadavers before attempting it on patients. The dissection of the tracts was done by the manner described and dummy radium tandems were implanted. The tractions were exposed and the locations of the 4 tandems were observed in their anatomical relations to the ureters, the blood vessels, bladder, rectum, and parametria, and their distances from the cervix and lateral wall of the pelvis were measured. The tandems were usually 1 to 2 centimeters lateral to the cervix, medial to the big blood vessels, and lateral to the ureters.

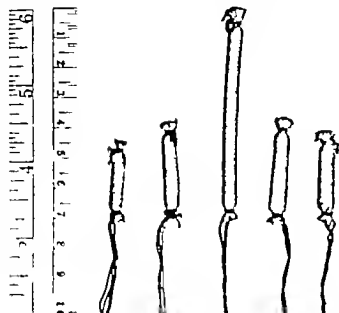


Fig 1

Fig 1. Photograph of the actual radium tandems used for this series of 100 cases. There are 4 rubber tandems (2 contain a 25 mm. tube of radium and 2 contain a 30 mm. or a 35 mm. tubes of radium) for interstitial implantation into the 4 carefully dissected tracts of the parametria and a long rubber tandem (either 30 mm. tubes or a 35 mm. tubes of radium) for intrauterine application. The tandems are made of Dakin's tubes (2 mm. of rubber) with strong silk strings attached. The filter is thus 1 millimeter platinum, 3 millimeter rubber. It will cause less necrosis than radon seeds (3 mm. gold filter).

Fig 2. Artist's drawing of implantation. Note the positions of the 4 tandems for interstitial implantation situated at equidistant points (2 to 3 cm. lateral to the cervix) at 2, 4, 8, and 10 o'clock positions. Note the absence of a contracervical application. The author believes they concentrate too large a dose of irradiation to the cervix and thus cause necrosis.

Fig 3. Photograph of a roentgenogram showing the locations of tandems and the long intrauterine tandem (the 2 large radium capsules centrally located). Note that the 2 tandems in either parametrium are about one-half the distance from the middle of the pelvis (intrauterine canal) to its lateral wall thus giving a wide and equal distribution of a lethal dose (1200 mmm. hrs. of radium) to either parametrium.

dissection was difficult and probably too dangerous. Interstitial therapy would surely cause more fibrosis and thus increase the possibility of late complications, i.e. urinary obstruction from stricture of the ureters, sciatic nerve pain from the pressure of scar tissue on the sciatic nerve plexus or stricture of the rectum.

2. **Infection.** An occasional patient, usually with the infiltrative type of lesion still had too much infection present following the

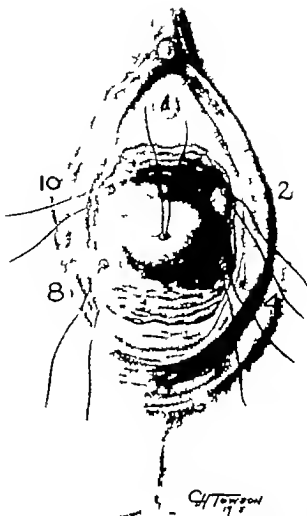


Fig 2



Fig 3

previous radiotherapy to justify the risk of dissection and parametrial implantation of radium. A persistence of infection was nearly always due to two causes (1) radiation necrosis from a previous overdosage of radium concentrated to a small area or (2) uncontrolled cancer. A combination of local infection and radiation necrosis was usually a sign of a bad prognosis.

3 *Advanced cancer* Many times examination under anesthesia would reveal a more advanced lesion than was thought present before operation. This has been a common error. Many of the cases, especially in the early days of development of the new technique called stage III we would now classify as stage IV. The personal equation and enthusiasm of different authors vary and thus the differences noted in the classifications of the clinical stages of cervical cancer.

ADVANTAGES OF INTERSTITIAL RADIUM THERAPY

The author claims the new technique of interstitial radium implantation into the parametria has the following advantages: (1) It eliminates the necessity for an abdominal operation. (2) Positive biopsies after treatment are less than was noticed by the older method of therapy; thus the 5 year cure rate should be higher. (3) It gives a more equal distribution and higher total dosage of irradiation in the parametria and lymph nodes of the pelvis. There have been only 4 cases (4 per cent) of death from urinary obstruction due to parametrial extension as contrasted with the 20 to 35 per cent as recorded in the literature. (4) The filter (1 mm pt. + 2 mm of rubber) causes less necrosis than radium needles or radon seeds. Radon seeds have a filter of 3 millimeter of gold which allows enough beta rays to pass through to cause necrosis adjacent to the seeds. (5) There is no danger of puncturing a blood vessel, ureter or bladder when the blunt rubber tandems are inserted into the four carefully dissected tracts. This is a serious danger when radium element needles or radon seeds are inserted blindly into the parametrium. (6) Radium element needles with silk strings attached will occasionally get hung in the tissues on attempted removal. Several

observers have had this embarrassing experience making operative removal necessary. This mishap has not occurred with the rubber tandems placed in the carefully dissected tracts.

COMPLICATIONS OF INTERSTITIAL RADIUM THERAPY

The possible complications of this new technique for interstitial implantation of radium into the parametria were both early and late.

Early complications The dangers or possible early complications from the operation were as follows: (1) damage to the ureters with extravasation of urine; (2) damage to a large blood vessel with hemorrhage; (3) opening the peritoneal cavity with peritonitis as a result; and (4) pelvic cellulitis through any one of the four openings into the parametria. In this first 100 patients treated by the new technique none of these possible mishaps have occurred. This fact alone convinces the author that the new technique is certainly a safe procedure and could be learned easily by any radiotherapist with surgical training. Cystitis, proctitis, irradiation sickness and erythema with desquamation of the skin around the pelvis were noted with about the same frequency with the new technique as was noted by older methods. They were at times troublesome and annoying to the patient but never serious.

Late complications The late complications from interstitial radium implantation were more serious than the early and were noted as follows: (1) A fairly severe proctitis was the most common late complication and was noted in 6 patients, 1 of whom developed a stricture severe enough to require colostomy. The other 5 patients still have occasional attacks of diarrhea with bloody mucus in the stools. Proctoscopic examination showed the typical picture of irradiation proctitis, usually most pronounced about 6 to 8 centimeters above the anus. All 6 of these patients are clinically free of cancer. (2) Rectovaginal fistulas have been produced in 4 patients, 3 of whom probably had stage IV cancer and should not have been treated by interstitial therapy. All 3 of these patients have necroses, fistulas, and still have positive biopsies after the heavy total dose of irradiation given in this series. The fourth patient is living and clinically free of

cancer over 5 years but she still has the fistula. The author considers this fistula was due to overirradiation. (3) Irradiation necrosis of the cervix was present in several cases, especially the late stage III (or IV²) cases in most of which cancer was still present locally in the cervix after treatment. One patient has developed late irradiation necrosis of the cervix several months after treatment and is still clinically free of cancer. (4) Urinary obstruction was the ultimate outcome in 4 patients each of whom had cancer clinically in the parametrium and in 2 cancer was proved by autopsy. This complication was studied carefully because interstitial radium therapy always produces more fibrosis than external irradiation. It is certainly safe to say that extension of cancer into the parametrium was several times more common as the cause of obstruction to the ureters than irradiation fibrosis. (5) Secondary vaginal hemorrhages were a serious complication in 7 cases. There was also 1 fatality from rectal hemorrhage. In every case of secondary hemorrhage the patient had uncontrolled cancer in the cervix.

Briefly to summarize the complications of interstitial irradiation there were no early complications from the implantation but there were 6 cases of irradiation proctitis, 1 case of rectovaginal fistula and 1 case of radiation necrosis of the cervix as late complications. All the remaining cases of fistulas, necroses, secondary hemorrhages, urinary obstructions and distant metastases were due to uncontrolled cancer and not to overirradiation.

RESULTS

The primary purpose of this paper was to show the necessity of interstitial radium therapy for cancer of the cervix and the advantages of a new technique used by the author in 100 cases. It is not a 5 year study as a few of the patients were cared for less than 5 years ago. Seventy-six patients (76 per cent) are still living and under observation and 24 patients (24 per cent) have died of cancer. The known causes of death were as follows: 3 patients had rectovaginal fistulas, 2 had bone metastases, 2 had pulmonary metastases, 4 died of urinary obstruction, 7 had secondary vaginal hemorrhages, and 1 died of rectal hemorrhage.

SUMMARY AND CONCLUSIONS

From a study of the 5 late complications of irradiation the causes of death in 24 patients and the high percentage of positive biopsies of lymph nodes of the pelvis found at operation by surgeons it should now be obvious that a higher total dose of irradiation should be given to the cervix and a much higher total dose equally distributed throughout the parametria and lymph nodes of the pelvis.

1. There were no early complications from the interstitial implantation of radium but there were 6 cases of irradiation proctitis, 1 case of rectovaginal fistula and 1 case of radiation necrosis of the cervix as late complications. The 24 deaths were the result of uncontrolled cancer of the cervix and adjacent parametrium.

The advantages and contraindications of the new type of interstitial therapy were discussed in detail. Emphasis was placed on the greater safety of this procedure over other forms of interstitial therapy.

The author has tried to accomplish the following: (1) To eliminate the necessity of a major radical procedure for early carcinoma of the cervix. (2) To improve the complete radiation of the growth in the cervix. There have been 176 positive biopsies after treatment thus the 5 year cure rate should be better. There have been only 4 deaths (4 per cent) from stage II cancer of the cervix and none from stage I. This rate is far better than was obtained by previous methods of radiotherapy. (3) To reduce the number of deaths from parametrial extension of cancer by giving a higher total dose of irradiation equally distributed throughout the pelvis. This has also been effected as only 4 deaths (4 per cent) were due to urinary obstruction contrasted with the usual 20 to 35 per cent recorded in the literature.

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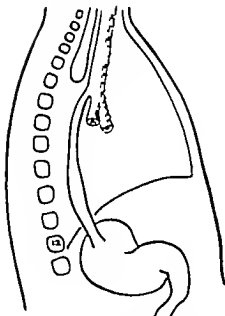


Fig. 1 Schematic representation of abnormality in case here reported. Upper end of the esophagus ends blindly. Lower end of esophagus communicates with posterior portion of lower part of the trachea. Superior segment of the esophagus is slightly dilated while the inferior one is quite small.

of saliva appeared in the baby's mouth and it was necessary on several occasions to suck these away in order to establish a satisfactory airway. On the second day of life a dilute formula was offered but the feedings were promptly regurgitated. All attempts at feeding were followed by respiratory difficulty and cyanosis. The infant was seen in consultation by Dr. Adelman and was referred to this hospital with a diagnosis of esophageal atresia.

Physical examination on entry showed a well developed and well nourished white male infant in no acute distress. Temperature was 99.2° degrees F, respirations 24, pulse 120. The color was good and there was no cyanosis at the moment. The skin had a slightly icteric tint which was regarded as a physiological jaundice. The head, eyes, ears, nose and throat were normal. The sides of the chest moved equally, there was no intercostal retraction. The percussion note was resonant over both lung fields. There were numerous fine, moist rales and coarse rhonchi throughout the entire chest, more marked at the right apex. The heart was not enlarged to percussion. The cardiac sounds were of good quality and the rhythm was regular. There was no murmur. The abdomen was slightly tympanitic, and was normal to palpation. The liver edge was felt just below the costal border. The genitalia, extremities and reflexes were normal. By rectal examination meconium was found on the examining finger.

Röntgenologic examination was made immediately after admission. Under the fluoroscope a No. 8 French urethral catheter was passed through the infant's nose and down into the esophagus. The catheter would not pass into the stomach since it met

some obstruction in the middle portion of the esophagus. Two cubic centimeters of lipiodol were now introduced through the catheter. A blind esophageal pouch (atresia) was demonstrated at the level of the 4th thoracic vertebra (Fig. 2). Fluoroscopy and film studies showed a considerable amount of gas scattered through the stomach and intestines indicating the existence of a fistula between the trachea and the lower segment of esophagus. There were patches of atelectasis and emphysema throughout both lung fields, the changes being most marked in the right upper lobe.

The infant was placed in an oxygen tent. The upper blind end of the esophagus was kept cleared out by an insulating catheter which was passed in through the nose and was connected to a Wangensteen suction apparatus. Intramuscular penicillin was started in doses of 3,000 units every 3 hours. Sodium sulfisiazine was given subcutaneously with 200 mg. of streptomycin and subsequent doses of 400 mg. of streptomycin. Parenteral fluids were administered in 100 cubic centimeters of 5 per cent albumin intravenously and 100 cubic centimeters of 10 per cent glucose in 0.47 per cent saline intravenously. After 52 hours of this therapy the infant had a tracheostomy performed from the left side. The tracheostomy seemed optimal for

ventilation. By R.I.C. under cyclopropane anesthesia with a tightly fitting face mask.



Fig. 2 Lateral roentgenogram, with baby in upright position. A catheter has been introduced into upper portion of the esophagus and a cubic centimeter of lipiodol has been instilled. This iodized oil outlines lowermost extent of the blind upper sac. Air in the stomach and intestines indicates that the trachea must communicate with the lower esophageal segment.

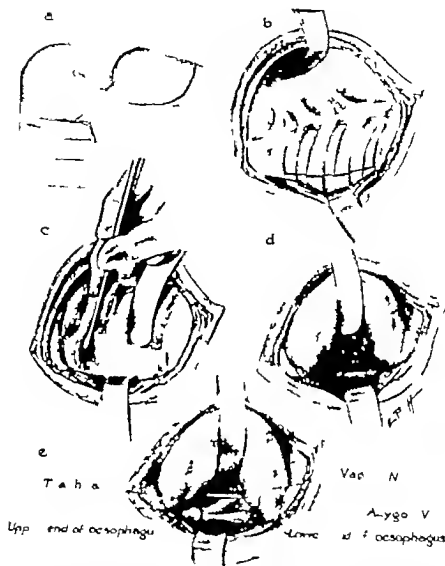


Fig. 3. Operative approach after Lanman, Ladd, and Haight and Towseley. a, Curved incision, dividing lower part of the trapezius muscle and the rhomboid major so that the scapula can be retracted laterally. b, Scapula retracted. Portions of 3rd, 4th, and 5th ribs resected subperiosteally. c, Intercostal muscle bundles will be cut posteriorly along the black line. d, Parietal pleura off the posterior chest wall and pushing it forward. e, Azygos vein coming into view in depths of wound. Azygos vein divided, entrance to mediastinum provided. Mediastinal structures exposed.

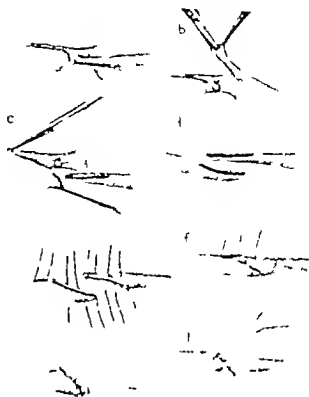
the infant was placed in a prone position with the right shoulder elevated slightly (Fig. 3). A curved incision was made just inside the medial border of the right scapula running downward and outward around the angle of the scapula. The superficial muscles were divided and the scapula was reflected upward and laterally and the costal cage exposed. The erector spinae muscles were mobilized slightly toward the midline. Subperiosteal resection of the segments (about 3 cm long) of the 3rd, 4th and 5th ribs was now carried out. The bundles of intercostal muscles with their accompanying nerves and vessels

were divided. The pleura was then stripped forward by blunt dissection from the vertebral bodies and the azygos vein exposed. This vein was doubly ligated and divided. Dissection was continued until the mediastinal structures were adequately exposed. The upper blind pouch of the esophagus extended down to a point opposite the lower portion of the trachea. The lower segment of esophagus had a fistulous communication with the posterior surface of the trachea about $\frac{3}{4}$ inch above the carina (Fig. 4a). There was some thin areolar tissue between the two esophageal segments. The lower part of the

esophagus was now extensively mobilized as far down as the diaphragm though this was accomplished at considerable risk to its blood supply. The tracheo-esophageal fistula was ligated with No. 0000 silk close to the trachea and was then divided (Fig. 4b). A long slit was cut in the lower esophageal tube. The upper esophageal pouch was extensively freed from surrounding structures up to the base of the neck. The thinnest area of this pouch was on its anterior surface along which an opening was made. Stay sutures of No. 00000 silk were placed in the four quadrants of each esophageal end. The No. 8 urethral catheter in the nose and upper esophagus was now pushed downward by the anesthetist so that it could be threaded into the lower segment and into the stomach. The near ends of the stay sutures were first tied following which the far ends were tied and thus the walls of the esophagus were rolled inward at the anastomosis. Next 7 or 8 interrupted sutures were used to join and turn in the musculature between the stay sutures. An effort was made to establish an oblique type of union in the belief that this might have less tendency to subsequent stricture formation. In anticipation of this type of junction slits had been made in each segment and it was thought desirable to make each slit where the respective segment seemed thinnest. In each case this was on the anterior surface. Unfortunately this procedure necessitated rotating the lower segment through a twist of 180 degrees in order properly to appose its opened end to that of the upper pouch (however this twist has in no way interfered with the subsequent function of the esophagus). The mediastinum was thoroughly irrigated with saline soaked out, and then filled with 25,000 units of penicillin solution. A narrow strip of soft rubber drain was placed near the anastomosis and was led out through the inferior angle of the skin wound. The chest was repaired by joining the intercostal muscle bundles posteriorly closing the superficial muscle layers and then approximating the skin. Debridement of No. 00000 silk on traumatic needles was employed throughout the procedure for both the esophageal anastomosis and the wound closure. The infant stool the operation quite well.

Postoperative course. The baby was again placed in an oxygen tent which was discontinued in 24 hours. Four hours after operation breast milk was injected through the indwelling gastric tube and was increased in a few days to supply full caloric requirements. A transfusion was given after operation and on the following day. Clysers were continued for 4 days. The infant's pulse and general condition were extremely satisfactory throughout the postoperative period. The mediastinal drain was removed on the 5th day there having been a discharge of only a few cubic centimeters of thin, serous, sanguinous fluid. The wound was solidly healed at the time of removal of sutures 3 days later.

Since we were unwilling to attempt feedings by mouth at so early a date and since we did not care to leave the nasal tube in place for a longer period a



Stomach tube was inserted into the lower esophagus. At the time the baby was moved and gastric tube was inserted into the stomach. Latent breast milk was taken up with caution. Since all particles of milk were swallowed with uterine tube the lungs were increased rapidly in an untimely manner. Because of difficulty with the infant's glutition the gastric tube was left in place and the baby was discharged home on the 10th day weighing 7 1/2 lb and taking full breast milk. Mouth Sulfazolin was used for 1 week after the mediastinal operation. Mediastinal drainage continued for the whole period of hospitalization.

Since leaving the hospital the baby has had a most satisfactory course. The feeding has been taken easily and with facility. The infant has usually been kept in a room with fresh air but has taken longer. The child has gained a few pounds in the diet has not returned to a normal weight. At no time has there been any purulent discharge after the act of feeding. The respiratory system has been healthy and that has been a



Fig. 5. Photograph of back on 9th postoperative day. The wound healed without infection and without esophageal leakage.



Fig. 6. Photograph of patient 16 months of age showing excellent general status.

quickly through the esophagus. There has been some visible constriction at the site of anastomosis and the lumen of the esophagus above this level has been somewhat larger than the lumen below it. However dilatations of the esophagus were not done at any time during the first year of life. The child's general physical condition has been excellent (Fig. 6) and the weight gain has been most pleasing (Fig. 7).

At about 1 year of age the child began to have some difficulty with swallowing of solid food and was returned to the hospital for short periods in the 13th

14th, and 15th months of life at which time the esophagus was dilated respectively to No. 30 (French) No. 30 and No. 41. Following this last and more thorough stretching deglutition has been very satisfactory. When last seen at 20 months of age there was no hesitation in swallowing.

DISCUSSION

At least five methods of primary anastomosis have been successfully employed for repair of esophageal atresia. Each of these procedures has certain factors which recommend it as a valuable approach to the establishment of esophageal continuity in infants. Final evaluation of each method is not possible until larger series are available for study but it is fitting at this time to point out some of the apparent merits or drawbacks of the different forms of anastomosis.

Haight (2,3) has recommended a primary repair whereby the tiny and thin distal segment is telescoped for a short distance into the upper segment in such a way that the entire thickness of the wall of the lower segment is joined by interrupted sutures to the mucosa and the submucosal layers of the upper segment (Fig. 8a). The muscularis of the upper segment is then lapped over and attached by sutures to the muscularis and adventitial structures of the lower segment.

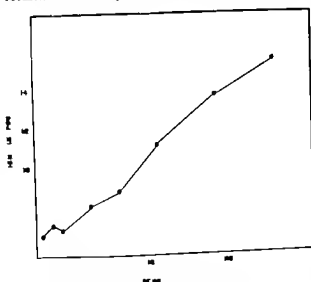


Fig. 7. Patient's weight chart for first half year of life indicating satisfactory gain.

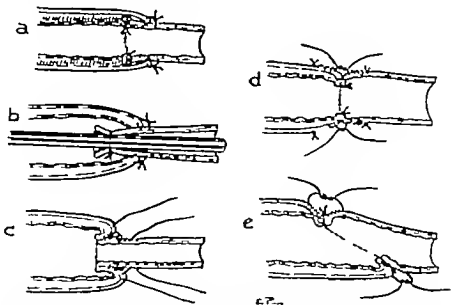


Fig. 8. Schematic drawings of types of esophageal anastomoses. a, Method of Haight. b, Daniel's procedure. c, Humphrey's technique. d, Ladd's method, employing tension sutures to relieve strain on line of union. e, Operation here reported. Ends of multiple bite sutures are tied opposite ends of these sutures are then being tied to roll in ends of esophagus. Oblique anastomosis.

The outstanding advantage of this method would appear to be in the sleeve-like overlapping of the muscular layers which obviously should give a great deal of strength to the anastomotic repair. The greatest drawback with this method would probably be the difficulty of placing the first row of interrupted sutures since the distal segment is usually small quite friable and easily torn. Hence there is considerable chance for the sutures to cut through or pull out, particularly if the segments have to be drawn together under any great tension. Aside from any theoretical disadvantages of the method, Haight's experience to date shows that in 3 cases a brilliant result has been obtained the babies have not needed gastrostomies and each has been able to take feedings satisfactorily. In 2 patients a fistula developed through the back, but each has healed spontaneously. In another individual, a tracheo-esophageal fistula reopened. Hence in each of these latter 3 cases it is obvious that some portion of the union had broken down after operation. Nevertheless Haight's reports have shown more recoveries from direct anastomoses than has any other publication to date.¹

¹Since completion of this manuscript one of us (R. E. G.) has attempted several more operations for esophageal atresia by the Haight technique. One of these has survived and at the moment we feel that this is the best method yet devised for esophageal anastomosis in babies with esophageal atresia.

Daniel employed an ingenious method for the surgical union of the two segments in esophageal atresia. After freeing and opening the upper and lower ends a catheter was placed in the nose led down through the upper segment, and threaded through the lower segment into the stomach. This catheter was used for upward traction after the esophageal end was tied to it. Thus the lower part of the esophagus could be pulled inside of the upper segment, to which it was then anchored with a number of interrupted stitches joining the muscle layers (Fig. 8b). The chief disadvantage with this procedure would seem to be that the esophagus is completely obstructed until the encircling ligature breaks or until it cuts through the esophageal substance. During this period of total obstruction saliva can accumulate and possibly spill over into the larynx and trachea. Some of this difficulty might be obviated by very careful nursing care during the postoperative period, so that any accumulated fluid could be frequently sucked out of the mouth and pharynx. It must be pointed out that Daniel was able to overcome a defect in which there was a very long separation between the two esophageal segments. Whether or not such a method will be productive of a higher percentage of strictures at the anastomosis site is as

It is needless to emphasize that great delicacy must be employed in the performance of esophageal anastomosis in babies. The tissues particularly of the lower segment, are extremely fragile and are easily injured. Every effort should be made to handle them with utmost gentleness and to avoid squeezing them with hemostats, forceps, or other instruments. The stay type of suture advised by Ladd provides an admirable handle for traction and for manipulating the esophagus. When one of these stitches has been placed all subsequent sewing can be accomplished without grasping the esophagus with a metallic instrument. In the case here reported it seemed to us of considerable importance that the esophagus was not touched with forceps more than three or four times during the entire surgical procedure. To complete such tiny operations successfully it is necessary to have a few instruments of diminutive size. A small blunt periosteal elevator or a septum elevator-dissector is essential for stripping the parietal pleura from the thoracic cage and the mediastinal structures. Tissue forceps should be no more than 3 or 4 inches in length and should have delicate toothless points. Scissors may be curved or straight, but should be no more than 3 or 4 inches in length. Of prime consideration is the type of suture material and the needle upon which it is threaded. We believe that fine braided silk is superior to any other type of suture material. Size No 00000 has adequate strength and a very small caliber. When attached to a No 9 Dehnatell atraumatic needle, it makes a superb material for use in babies.

The choice of anesthetic agent must of course depend upon the circumstances in a given clinic. Local novocain infiltration has been frequently employed. Avertin plus novocain has been favorably commented upon in some instances either has been preferred. Various authors have condemned general anesthesia but we are convinced that it greatly facilitates the performance of the operation and need not be productive of shock or untoward reaction. In the case here reported and in other instances in this hospital cyclopropane has been the anesthetic of choice. It gives sufficient relaxation and

carries a high concentration of oxygen. When supplied through a tightly fitting face mask it can be given under positive pressure if by accident the parietal pleura should be pierced at any time the lung can be easily expanded. Our selection of cyclopropane has been dependent upon the availability of an expert anesthetist who has had wide experience with its use in babies. Where such conditions do not prevail local anesthesia would probably be safer.

Discussion has arisen concerning the advantages of leaving a small rubber tube in the reconstructed esophagus. In our case a No 8 French catheter was led through the nose, down through the esophagus and into the stomach—and kept there for 8 days. We considered it to have value as a semi rigid structure for keeping the segments of the esophagus in line. Furthermore it was enormously useful for feeding purposes during the immediate postoperative period. Conceivably an intubating catheter can produce pressure necrosis in the anastomotic area but we are inclined to minimize this danger. Previous experience indicates that some infants will tolerate a tiny rubber tube in the nose for protracted periods of time while others develop such a violent reaction to it that nasal stuffiness and accumulation of secretions greatly embarrass the baby's breathing. In short if a catheter is tolerated well it is probably a valuable therapeutic agent. If however too much reaction is set up in the nose or throat it is folly to keep a tube in place.

The use of a gastrostomy is likewise a moot point. In the present case gastrostomy was performed 8 days after the esophageal repair but it was kept open for only a week. This patient fared so well that possibly he could have survived without the gastric opening. In 3 of Haight's patients no gastrostomy was employed. In general it would seem to us that the establishment of a Stamm gastrostomy under local anesthesia can be such an innocuous procedure that it should be almost universally done a day or two after the esophageal repair. The intubating esophageal catheter could be omitted and all oral feedings could be withheld for several weeks in order

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SUMMARY

to allow the best possible esophageal healing. While this routine would obviously impose a gastrostomy on some patients who might have survived without it there would doubtless be improvement in overall results when employed in a series of cases.

Observations are reported upon a baby with congenital atresia of the esophagus and associated tracheo-esophageal fistula. Surgical correction was undertaken through a right, extrapleural mediastinotomy. The tracheo-esophageal fistula was closed and the two esophageal segments then joined by a long oblique anastomosis.

The baby was discharged from the hospital 19 days after operation. Esophageal dilations were not required during the ensuing year but were performed thereafter. The child is in excellent health at 20 months of age. The surgical method is one which can be employed only when the esophageal segments lie close to one another or when they can be adequately mobilized to allow satisfactory approximation. Under such circumstances, the technique merits further trial in future cases.

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The necessity for esophageal dilatations and the frequency with which they must be repeated will depend upon the tightness of any existing stricture and the severity of the dysphagia. The size and the function of the esophageal canal can be observed by a swallow of barium (or lipiodol) and fluoroscopic examination. However we are convinced that esophageal dilatations should not be performed solely on the basis of any roentgenologic findings which suggest a constriction at the site of anastomosis. Indeed, the indications for dilatation should depend almost entirely upon the subjective symptoms which occur during the ingestion of feedings. One gains the impression that scar tissue (if not too great) at the site of an anastomosis may give trouble for a temporary period, but that the symptoms can become much less as the child grows older and the esophageal lumen becomes greater. In short the lesser degrees of stricture may be troublesome at first, but they do not necessarily imply that dilatations will be required indefinitely.

PANCREATIC HETEROTOPIA

Review of the Literature and Report of 41 Authenticated Surgical Cases, of Which 25 Were Clinically Significant

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THE presence of pancreatic tissue in an aberrant location, without connection with the main pancreas can at the present time no longer be considered merely as a rare and casual post mortem discovery or as an unusual and interesting but incidental finding at operation. In view of the multiple surgical cases of clinical significance reported in the medical literature it is a condition that should be kept in mind, recognized, and taken into due consideration by the surgeon who operates on the gastrointestinal tract.

In the past 5 years there has been an increased interest, both of the clinician and of the surgeon in conditions referable to the pancreas. Much study has been done in various sectors in this field. Much of this work has been dedicated to the clinical study and surgical treatment of hypoglycemia and hyperinsulinism. There have been examples reported in which aberrant pancreatic tissue was the site of hyperfunctioning insulin-producing, benign or malignant neoplastic tissue. The presence of a functioning aberrant islet cell adenoma or adenocarcinoma can possibly explain the enigma of some cases of idiopathic or so-called spontaneous hypoglycemia, in which an exploration does not reveal the presence of any tumor in the main pancreas.

Aberrant pancreatic nodules have at certain times caused embarrassment to the surgeon. At other times far from being merely an incidental finding heterotopic pancreatic tissue has been known to be the

source of considerable trouble and to be the cause of serious conditions for which a major surgical procedure had to be instituted to obtain relief.

The collection of cases in the literature especially in the more recent years, has been illustrative and revealing. The reports however have all been accounts of isolated instances and no large group of cases has yet been presented from one single source. The largest series being that of Branch and Gross, who presented 24 cases in only 5 cases however was heterotopic pancreatic tissue encountered at operation and in only 4 was it causative of symptoms.

In an endeavor to make a substantial contribution to the casuistics of this subject we have attempted to make a detailed clinical and pathologic study of all the surgical cases of pancreatic heterotopia found in the records of the Mayo Clinic. There is a relatively large group of cases with clinical significance especially in the more recent years.

MATERIAL AND METHODS

We reviewed a series of 82 surgical cases. Twenty five of these were authentic cases (confirmed by microscopic examination) of pancreatic heterotopia in which the heterotopic pancreatic tissue was clinically significant, in that either it was found to be the only or main lesion for which the patient was taken to the operating room or it was one of the lesions contributing to the production of symptoms. These cases are summarized in Table I.

Sixteen cases of the series were authentic cases of pancreatic heterotopia in which the heterotopic pancreatic tissue was merely found incidentally at operation during the course of a surgical procedure performed for some other lesion.

Abridgment of thesis submitted by Dr. Barbosa to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of M.S. in Surgery. From the Division of Surgery Mayo Foundation, and the Section on Surgical Pathology and the Division of Surgery Mayo Clinic.

TABLE I—SUMMARY OF AUTHORS' 25 SURGICAL AUTHENTIC CASES OF PANCREATIC HETEROTOPIA WITH CLINICAL SIGNIFICANCE

Case Year Sex Age	Macroscopic and microscopic location of pancreatic heterotopia Histologic evidence of active function	Size of mass Pathologic change	Symptoms	Roentgenologic contributions	Operative Results
014 F 42	Lesser curvature and posterior wall of stomach. Submucosa and infiltrating muscle layers. No	3.5 x 1.5 cm. (vulvar). None	Ulcer history. Pain 16 hrs. p.d. Loss 5 lbs weight in 3 yr.	Ovoid tumor mass mid-portion of stomach. Malignant	Partial gastrectomy, posterior Polya. Good immediate results since operation in June, 1911
014 M 33	Greater curvature pro-pyloric region of stomach. Submucosa and between muscle bundles. No	5 cm. in diameter. None	Past history of ulcer symptoms	Filling defect 3 cm. in diameter near greater curvature just proximal to pylorus	Excision. Good immediate results since operation May 1944. Wally 1 mm p.
3 1911 M 44	Stomach posterior wall greater curvature ca. above pylorus. ?	3 mm. in diameter. Slight retraction of mucosa 2.5 cm. in diameter resembling diverticulum, superficial erosion	Recurrent epigastric pain periodically for 23 yrs. At present no relief with diet	Duodenal ulcer	Partial gastrectomy, posterior Polya. Grade 3 post-ileitis with multiple superficial erosions.
017 M 41	Greater curvature of stomach ca. proximal to pylorus. ?	cm. in diameter. None	R.U.O. pain worse immediately p.c. for 3 yrs. No relief with diet	Polyp cm. in diameter near greater curvature in antrum	Partial gastrectomy, posterior Polya. Well 3 yrs p.c.
1 013 M 24	Pylic end of stomach. Submucosa and infiltrating muscle short. No	erect cm. None	Epigastric distress—none	Polypoid lesion 2.5 cm. in diameter in pyloric segment of stomach	Partial gastrectomy, posterior Polya. Well 3 yrs p.c. Well 3 yrs p.c.
010 M 38	Posterior wall of stomach just above angle. Submucosa and infiltrating muscular short. Yes	2.5 cm. Multiple large cysts were grossly in mass, dilated ducts	Upper abdominal distress 3-4 yrs. p. With food, acids and alkalis (transmucosa relief but diet without result). 5 yrs. Loss 20 lbs. Past yr. episode of hemorrhage	Design tumor in stomach 3 cm. in diameter. Just above lesser curvature above angle. Lymphoma?	Caution excision of gastric wall containing tumor. General condition fair. Some epigastric distress weight normal 4 yrs. 5 mm p.c.
1 011 F 23	Posterior wall of stomach proximal to pylorus. Submucosa. Yes	4 mm. in diameter. None	Epigastric distress with nausea hrs. p.d. for 2-3 yrs.	Polyp cm. in diameter on posterior wall of pro-pyloric region of stomach	Partial gastrectomy, posterior Polya. Well 9 mm. p. Well 3 yrs p.c.
010 M 35	Serosal surface pyloric ring. Submucosa. Yes	1 cm. in diameter. None	Periodic epigastric distress with burning and acid relief 4 yrs. Loss 25 lbs. 13 lbs. in 4 mos	Annular lesion involving pylorus in pro-pyloric area with duodenal malignancy?	Partial gastrectomy, posterior Polya
010 M 30	Stomach, lesser curvature. Submucosa. ?	cm. in diameter. Abscess pericyst directly below circumference ulcer (1). Malignant change	Ulcer history 3-4 yrs. hematemesis, tarry stools	Perforating ulcer lesser curvature of stomach	Partial gastrectomy, posterior Polya. Died 37 mos. p.c.
013 M 43	Stomach, lesser curvature. Submucosa. Yes	cm. in diameter. Hemorrhage	Daily ulcer symptoms past 5 mos.	Duodenal ulcer. Ulcer lesser curvature of stomach	Partial gastrectomy, posterior Polya, partial duod. oc. by S&J. Satisfactory 6 mos p.
1 M 39	Duodenum. Infiltrating longitudinal muscular fibers. Yes	3 x 1.5 cm. None (overlying duodenal ulcer).	Epigastric pain, no relief with diet, 3 yrs. Hemorrhage. Loss 1 lb. 3 yrs.	Duodenal ulcer, large crater	Partial gastrectomy, posterior Polya
013 M 33	First portion duodenum. Submucosa, infiltrating circular muscular fibers. Yes	? None (duodenal diverticulum)	Erythema of bleeding duodenal ulcer. Secondary anastomosis	Duodenal ulcer	Partial gastrectomy, posterior Polya. 3 mos. p. Very well 3 yrs. 3 mos. p.c.
1 1930 F 31	Inferior border duodenum. 5 cm. from pylorus. Submucosa. Yes	5 cm. in diameter. None	Epigastric distress 3 1/2 yrs. Temporary relief with antacids, tarry stools	Negative stomach and duodenum. Gastrobladder partially functioning with stress	Bronchus, subdiaphragm. No ducts and pancreas normal. Excision of duodenal nodules. Well 3 yrs 4 mos p. Well 14 yrs p.
14 1911 M 38	Duodenum 5 cm. below pylorus. Submucosa and infiltrating longitudinal and circular muscular fibers. Yes	5 mm. in diameter. None	Ulcer type of distress 5 yrs. Loss 10 lbs. No relief with diet.	Duodenal ulcer	No evidence of ulcer. Excision of tumor with portion of pyloric antrum. Reconstruction of pyloric outlet. General 12 lbs. Well 5 mos 13 yrs p.c. Working hard

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TABLE I.—SUMMARY OF AUTHORS 25 SURGICAL AUTHENTIC CASES OF PANCREATIC HETEROTOPIA WITH CLINICAL SIGNIFICANCE—Continued

Case Year Sex Age	Macroscopic and microscopic location of pancreatic heterotopia Histologic evidence of adrenal function	Size of mass Pathologic change	Symptoms	Radiologic examination	Operation Results
1 1913 F 6	Anterior wall duodenum just below pylorus. Sub- serosa No	1.5x0.8 cm. Necrosis	Epigastric distress with food relief 5-8 yrs	Pedunculated polyp ap- proximately 1.5 cm. first part duodenum greater curvature side	Excision of tumor with reconstruction of pyloric outlet. Well 15 yrs p.o.
16 1914 F 30	Duodenum 1.5 cm. below pylorus anteriorly	3x2.0 cm. Duodenal ulcer immediately above pancreatic heterotopia.	R.L.Q. pain 1 yr		Excision of duodenal ulcer with node of pancreatic heterotopia and Hirsch- Mitnick pyloroplasty Well 8 and 18 yrs. p.o.
17 1915 M 30	Anterior lower side of duodenum 5.5 cm. from pylorus	Small without. Inflamma- tory changes	L.U.Q. pain yrs.	Possible duodenal ulcer	Excision of nodule. Severe recurrence of symptoms yr p.o.
18 1915 F 6	Common duct Yes	Nodule (size?). Marked inflammatory changes with lymphocytic infiltration and necrosis	Gas and indigestion 10-15 yrs.	Nonfunctioning gallblad- der with stones	Cholecystectomy; drainage of common duct (com- mon duct increased to twice normal size). Well 10 yrs. p.o.
19 1916 M 25	Outlet of common duct. Subserosa	mass in diameter Car- cinomatous duodenal ul- cer overlying nodule. Malignant change of ac- cessory pancreas (?)	R.U.Q. p. in 4 mos Marked jaundice 5 mos Loss 27 lbs.	Stomach negative	Gallbladder enlarged 3-4 times normal size. Com- mon duct dilated. Trans- duodenal excision of nodule and duodenal adenocarcinoma. ul- cer. Drainage of gall- bladder. Died third day p.o. Paternity denied, brochopneumonia
20 1916 M 34	Gallbladder cm. from cystic duct. Subserosa	1x0.6 cm. None	Nausea and regurgitation. Intermittent jaundice 2 yrs.	Stomach negative	Cholecystectomy. Still dis- tressed 5 yrs. p.o.
21 1917 F 30	Between posterior wall of stomach and gastroesoph- ageal junction	8x3x1 cm. Cystic change	In 1914 yrs. 3 severe epiplo- ic of upper abdominal pain with nausea and vomit- ing. Palpable epigastric mass. Loss 45 lbs. in 6 mos.	Stomach negative. Gall- bladder nonfunctioning with stones	Accessory pancreatic mass removed. Marginalization of pancreatic cyst. G. 11/12 3/4 d. al d. Well until yrs. p.o. Died from "heart tack"
22 1917 F 20	Transverse mesocolon No	Length—10 cm. Width— 4.5 cm. .5 cm. Thick- ness—1.5 cm. Hetero- topia pancreatic cyst containing plasma, largest 4 mm. in diameter	Recurrent epigastric pain with vomiting	Stomach negative	Removal of tumor. Patho- factory 8 yrs. p.o. After trouble with pancreatic diabetes
23 1918 M 23	Abdominal wall (in om- phaloenteric cyst, 5 cm. in diameter). Sub- serosa of small bowel epithelium Yes	Cyst cm. in diameter. Fat necrosis with acut- e foreign body giant cells in surrounding tis- sue	Intermittent nausea, in- dignity and drainage in umbilical region since childhood		Removal of cyst intact. Excellent health. No recurrence of symptoms yrs. 4 mos. p.o.
24 1920 M 27	Tip of Meckel's divertic- ulum. Subserosa Yes	cm. in diameter None	Periodic attacks of "bilious- ness" yrs.	Gallbladder normally func- tioning	Removal of diverticulum. Appendectomy Well 4 yrs. p.o.
25 1921 M 4 mos.	Tip of ileal diverticulum Subserosa No	1.5x0.5 cm. Necrosis and hemorrhage	Crying and vomiting 1914 at 2 1/2 h. 1/2 "sausage-like" mass pal- pated over right flank		Excision 5 cm. gas- trotomy bowel. Hirsch enterostomy. Died 5 hrs. p.o. Shock

Fourteen cases were unconfirmed cases of pancreatic heterotopia which we interpreted as clinically significant. The heterotopic pancreatic tissue diagnosed grossly as such by the surgeon in these cases, seemed to be the

cause of persistence or recurrence of symptoms after an operation performed on an organ bearing lesions which could not explain the symptoms present.

Twenty seven cases were unconfirmed cases

TABLE II—CASES OF PANCREATIC HETEROTOPIA RECORDED IN THE LITERATURE SINCE FAUST AND MUGGETT'S REVIEW IN 1939

Year	Author	Organ	Cases
1937	Meyer May*	Stomach (Ca, Int.)†	
	White and Golden*	Neck pancreas (Int.)†	
	Lepidari*	Stomach	
1938	Picco (47)	Stomach (P.O.)†	
	Black and Packard*	Mackel's diverticulum	
	Cramer*	Stomach	
	Goldhill	Duodenum	
	Gotlib	Umbilical region	
1939	Crickshaw	Mesenterium	
	Isape	Stomach	
	Picco (48)	Stomach	
	Hirsch	Duodenum	
	Natala and Caccia	Duodenum	
	Martin and Caldwell	Mesenterium	
	Pachon	Stomach	
	Martinez	Mesenteric root (cyst)	
	Grout	Stomach (P.O.)†	
	Casals	Duodenum	
1940	Thomsen	Jejunum	2
	Darbysch	Gallbladder	
		Stomach	2
		Duodenum	
		Mackel's diverticulum	
		Mesenterium	6
	Roeder	Duodenum (P.V.)†	
	Jacobsen	Gallbladder	
	Cypella	Mesenterium	
	Koon, Mung and Ankerst	Splice (cyst)	
1941	Krug	Stomach (P.O.)†	
	Caher (4)	Stomach	
	Mancietta and Vinas	Duodenum	
	Urpain (49)	Liver (Ca, Int.)†	
	Salinger	Gastroepiploic anastomosis (Int.)†	
	Kirk and Walton	Duodenum (Int.)†	2
	Martins	Mackel's diverticulum	
	Mancietta and Vinas	Duodenum	
	Urpain (41)	Duodenum (Int.)†	
	Smith	Duodenum (Int.)†	
1942	Jorge and Lattuada	Jejunum	
	Vinas Urpain	Duodenum	
	Duff, Foster and Krysa	Duodenum (Ca, P.O.)†	
1943	Chapman and Manning	Duodenum	
	Volman, Wood and Stockton	Neck pancreas (Int.)†	
	Warren and Lenny	Duodenum (Int.)†	4
1944	Centre Barlowe	Stomach	24
	Docherty and Waugh	Duodenum	
		Jejunum	2
		Intestine	
		Mackel's diverticulum	
1945		Umbilical region	
		Gallbladder	
		Mesenterium	6
Total cases			91

*Cases not mentioned in Faust and Muggett's review but recorded in the literature prior to 1939.

†Ca = malignant lesion in heterotopic pancreatic tissue.

Int. = producing intussusception and causing hypopycemia.

Dev. = diverticulum of the duodenum.

P.V. = papilla of Vater obstructed by accessory pancreatic gland.

P.O. = pyloric obstruction.

of pancreatic heterotopia in which the heterotopic pancreatic tissue diagnosed grossly by the surgeon as such, was found incidentally during the course of an operation performed for some other surgical condition and was thought not to be of clinical significance.

GENERAL CONSIDERATIONS

Definition. Pancreatic heterotopia is defined as being the presence of pancreatic tissue outside its usual or habitual location and without anatomic relation either of continuity or of vascularization with the pancreas proper.

Literature. A complete review was made first of the early literature and second of the recent literature (Tables II and III). As precisely as we can determine, from 1727 to March, 1944, approximately 430 cases have been recorded in the literature to which we add the cases of our series (Table III) which includes 41 authentic cases and 41 unconfirmed cases.

Embryology and hypotheses of origin. Arcy gave a very clear description of the organogenesis of the pancreas. The classical descriptions are generally in agreement as far as the number and general topography of the pancreatic anlagen are concerned. They differ however when it comes to describing the phases through which the anlagen go in order to form the definitive pancreas. In 1939 Delmas presented his findings after following the evolution of the pancreas on reconstructions made by Born's method on human embryos from 5 to 27 millimeters in length. Delmas concluded that the total pancreas is completed at the 27 millimeter stage. According to his research, which was the most recent and thorough work that we found on this subject, the dorsal pancreas forms the head of the pancreas (primitive dorsal anlage) and the body and tail of the pancreas (bud from the dorsal anlage). The ventral pancreas forms the preduodenal process of the pancreas minor of Winslow and reinforces the dorsal part of the head of the pancreas. The ventral pancreas is the only anlage that tends to encircle the duodenum.

Practically all the concepts of the etiology of heterotopic pancreatic tissue maintain that

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TABLE III.—SUMMARY OF ALL RECORDED CASES*

Location	Warthin 1904	Horgan 1911	Simpson 1912	Hunt and Boonsteel 1914	Peppi 1933	Frost and Mudgett 1940	Present study from table 2†		Total	Per cent
							From Horgan- 1911, March, 1944	Anchors cases		
Wall of stomach	4	8	25	33	44	8	4	3	130	53
Wall of duodenum	10	4	4	3	20	3	5	4	30	27.7
Wall of jejunum	3	13	3		6				25	5.0
Wall of ileum		1							13	3.8
Diverticulum of stomach				3				5	5	1
Diverticulum of duodenum			10					1	14	3
Diverticulum of jejunum				4			7	3	5	3.3
Diverticulum of ileum		3	4	3					3	0.8
Mechel's diverticulum	3	1	6					1	0	4
Umbilical fistula						3			8	2.7
Mesentery						4			3	4
Omentum (gastrohepatic, gastrosplenic, gastroplic)	1					3			6	3
Spleen				1	1	1			3	4
Splenic capsule										
Gallbladder									1	0.4
Cystic duct						1			3	6
Common duct								3	3	4
Liver				1					1	4
Transverse mesocolon				1					50	37
Near pancreas					1				60	41
Mediastinal teratomatous cyst	3				36	36	38		104	471
Miscellaneous		49	24	67		2	1		13	100
Total cases										

* Individual contribution
 † Branch and Organ in text reported as cases of their own, besides an additional 10 from the literature.
 ‡ W did not include 4 serological cases of pancreatic heterotopia without microscopic confirmation.

this anomaly is antenatal in origin. It is evident that one single concept does not explain all cases however much basis of truth it possesses. Our attitude in regard to these hypotheses is eclectic. Of those concepts presented three deserve mention for being ones that seem most logical to us and that are based on embryologic knowledge—namely, Horgan's, Lordy's and Warthin's concepts. Horgan expressed the belief that before the coalescence between the two anlagen takes place during the partial circumrotation of the posterior and anterior pancreatic anlagen, when there is a migration of the body upward

the branching ducts, as a result of the organs being packed together come into contact with the walls of the mesentery, stomach, or in the walls of the duodenum in the opposite direction. On testine growing in the opposite direction because these they become engrafted because of noninflammatory adhesions of fetal life. Later during the growth and movements of the gland the attached part is pulled off and may continue to live incorporated as a graft in the gastric duodenal or intestinal wall or mesentery. The germinative cells, from which all the histologic units of the pancreas can develop are present in these buds or attached portions derived from the primitive anlage

TABLE IV — INCIDENCE OF HETEROTOPIC PANCREATIC TISSUE IN CONSECUTIVE NECROPSIES

Author	Necropsies performed	Heterotopic pancreatic tissue, cases	Per cent
Open	1,300	20	1.5
Horgan	311 ^a		1.6
McCall	1,070		
Dwyhyllre	8,012	124	1.5
Kramer	457	6	1.3
Katsenrad	279	4	1.4
Feyrtaf (1910)	1,100	3	0.3
Mascher	800	5	0.6
Lauwelle	80		2.4
Clinic series			
1930	185	6	
1940	178	10	5.6
1950	464		4
1960	150		
1970	631	10	1.6
Total	1181	48	4

^aExtracapsular/retroperitoneal tract opened in 314 cases.
^bFor clinic series.

This graft may find suitable environment and continue to live and develop into a small separate piece of pancreatic tissue constituting a pancreatic heterotopia with all the functions of the normal pancreas.

Lordy explained the presence of an accessory pancreas by stating that it is due to persistence or incomplete regression of the left ventral anlage which is normally destined to atrophy. Warthin described his concept of the origin of pancreatic heterotopia as follows:

It is probable that accessory pancreatic tissue is formed from lateral budding of the rudimentary pancreatic ducts as they penetrate the intestinal wall, the mass of pancreatic tissue thus formed being snared off and carried by the longitudinal growth of the intestine either upward or downward.

Incidence The incidence of heterotopic pancreatic tissue not only at necropsy but at operation was studied from reports in the literature and from our own findings in the surgical records and those of the Section of Anatomic Pathology of the Mayo Clinic. It is that the incidence at necropsy varies

TABLE V — PRECISE HISTOLOGIC LOCATION OF THE HETEROTOPIC PANCREATIC TISSUE IN 26 CASES

Location	Symptoms	No symptoms	Total cases	Per cent
In submucosa only	0	2	24	92
In submucosa and infiltrating muscular fibers	1		6	23
Between muscle fibers only			4	15
On the submucosa or serosal surface only			2	8
In the submucosa between the muscle fibers and in the subserosal tissue			4	15
Total	18	2	20	100

from 0.6 per cent to 5.6 per cent of routine necropsies (Table IV). At operation heterotopic pancreatic tissue is found once in approximately every 500 operations in the upper abdominal region.

There is a higher incidence of surgical cases in the fourth, fifth, and sixth decades of life than in other decades but the anomaly has been found in patients of all ages both young and old including infants and newly born. In our series the youngest patient was 4 months and the oldest patient was 64 years of age.

Location We particularly endeavored to determine the usual and unusual locations of pancreatic heterotopias. The duodenum, stomach, and jejunum are the most common sites with an incidence for the three sites of almost 70 per cent: 27.7 per cent for the duodenum, 25.5 per cent for the stomach and 15.9 per cent for the jejunum (Table III). All the other unusual locations are mentioned in Table III.

Morphology Heterotopic pancreatic tissue usually presents itself as a single, firm and, when visible, yellowish (light yellow or cream color) or white, opaque, lobulated, round, or irregular node with granular surface. The maximal diameter of the node is usually 1 to 4 centimeters. Its appearance is like that of the pancreas itself or of a salivary gland. Larger masses may be found (Fig. 1).

The histologic picture of heterotopic pancreatic tissue is frequently the same as that of the pancreas itself, with acini forming lobules with ducts and islands of Langerhans (Fig.

TABLE VI.—SUMMARY OF 6 CASES* OF PANCREATIC HETEROTOPIA ASSOCIATED WITH HYPOGLYCEMIA AND HYPERINSULINISM, COLLECTED BY THE AUTHORS FROM REPORTS IN THE LITERATURE

Case number and author	Patient, sex and age, years	Symptoms	Operative findings	Pathologic findings	Results
Vercil 1914 (one case)		No clinical history. Hyperinsulinism?	Large tumor near tail of pancreas	Large islet cell tumor (neoplastic adenoma) arising in accessory pancreas	
1. Fanta 1937 (one case)	Male 37	*Hypoglycemia and hyperchloridria	Removal of walnut sized nodule of aberrant pancreas in duodenum	Heterotopic pancreatic tissue, not adenomatous	Partial relief from symptoms
2. Meyer Apr. 1937 (one case)	Female 34	*Hypoglycemia. Loss of weight. Abdominal tumor. Roentgenogram suggested tumor between stomach and colon-pancreatic cyst?	Cystic tumor in stomach wall with communication with pylorus with gastric ulcer. No communication with pancreas. Removal of tumor and pyloroplasty	Cystadenocarcinoma of aberrant intragastric pancreas (epitheliocyst masses with cells like Langerhans cells). Gastric ulceration	Recovery
4. White and Gildes Aug. 1937 (one case)	Female 33	*Hypoglycemia. Four episodes nocturnal confusion, restlessness, headache, dizziness and trembling. No result with medical treatment	Removal of calcified tumor outside pancreas. In connective tissue surrounding it. No connection with pancreas	Calcified adenoma 1.5 x 1.5 cm with islet cell masses. No mitotic figures	Complete relief. Gain in weight
5. Bellinger Aug. 194 (one case)	Male 53	*Very low hypoglycemia (proved specifically not to be hepatogenic). Fasting—mental confusion and faintness, convulsions and coma (worse with rosettes)	Tumor 10x10 cm found in retroperitoneal area between upper border head of pancreas and epigastric lobe of liver. Infestation of liver irreparable. Biopsy	Mitotizing islet cell carcinoma of aberrant pancreatic tissue in liver containing hypoglycemia-producing substances	Hypoglycemia relieved. Fasting ed. cessant. No large amount of glucose for relief
6. Radd and Walton Oct. 194 (one case)	Male 40	*Stupor—unconscious with low blood sugar level. Dramatic recovery with glucose (Parkinson's syndrome). Hypoglycemia	Nodule in gastrosplenic omentum 5 cm. from tip of tail of pancreas. Firm, round, 3 cm. in diameter. No connection with the main gland	Islet adenoma (pink on cut surface)	Physical and mental improves. Normal glucose tolerance test
7. Smith Feb. 194 (one case)	Female 43	*Weakness—later. Appetite for sweets. Hypoglycemia. Relief of symptoms with food	Excision of nodule from descending duodenum	Nodule 1.5 x 1.5 x 0.5 cm. Weight 1 g. with acini, ducts and diffuse islet cells (not adenomatous)	Weakness better. No h. g. Gained 10 lbs.
8. H. J. M. d. Stockton Aug. 1943 (one case)		Dizziness and weakness with inadequate feeding and strain. Intermittent episodes of acute mental upset, irresponsiveness and coma. Hypoglycemia	1st operation. Excision of islet nodule near end of tail of pancreas, together with a portion of pancreas. 2nd operation. Excision of round black nodule between pancreas and spleen	1st nodule: Islet cell adenoma, 7 cm. in diameter and smaller islet cells nodule 1 cm. in diameter	No relief from first operation. Patient well yr. after second operation
9. H. J. M. d. Stockton Aug. 1943 (one case)	Female 61	Nodule found incidentally	Nodule in proximal duodenum found incidentally during surgery following death from peritonitis	Schrenkian islet cell adenoma	Dead

*This table also includes Vercil's case, as well as one case of islet cell adenoma without hypoglycemia and one case of islet cell cystadenocarcinoma with hypoglycemia, from the literature.

a) There may however, be a lack of one or another histologic element of the normal pancreas.

In the majority of the cases reported as well as in our own cases the type of mucosa directly overlying the heterotopic tissue is the same as the type of mucosa normally corresponding to that particular portion of the gastrointestinal tract where the heterotopic pancreatic tissue is situated. We were not convinced of any direct relation continuity or transition between the glands and ducts of the mucosal epithelium and the acini and ducts of the heterotopic pancreatic

tissue. The only possibility of indirect connection would be by means of the excretory ducts of the heterotopic pancreatic tissue emptying into the lumen of the gastrointestinal tract through the ducts of the mucosal epithelium. The commonest histologic location of heterotopic pancreatic tissue was found to be the submucosa alone with an incidence of 53.8 per cent. The second most common type of involvement was infiltration between the longitudinal or circular muscular fibers or both, with an incidence of 23 per cent. The least common location was the serosal surface (Table V)

TABLE IV—INCIDENCE OF HETEROTOPIC PANCREATIC TISSUE IN CONSECUTIVE NECROPSIES

Author	Necropsies performed	Heterotopic pancreatic tissue, cases	Per cent
Oyle	1,200	10	6
Horgan	117*		6
McGill	1,070	11	
Derbyshire	1,011	101	
Kroner	267	6	3
Katsuruda	139	6	.8
Feyrer(77,11)	1,100	11	3
Mouchet	200	3	3
Letulle	150	13	8.6
Clinic series			
1920	211	6	
1940	275	10	7
1941	254	11	4
1942	211	11	
1943	61	10	6
Total†	5,251	113	7

*Excludes gastrotubercular tract spread in 214 cases.
†Of clinic series.

This "graft" may find suitable environment and continue to live and develop into a small separate piece of pancreatic tissue constituting a pancreatic heterotopia with all the functions of the normal pancreas.

Lordy explained the presence of an accessory pancreas by stating that it is due to persistence or incomplete regression of the left ventral anlage, which is normally destined to atrophy. Warthin described his concept of the origin of pancreatic heterotopia as follows:

"It is probable that accessory pancreatic tissue is formed from lateral budding of the rudimentary pancreatic ducts as they penetrate the intestinal wall, the mass of pancreatic tissue thus formed being snared off and carried by the longitudinal growth of the intestine either upward or downward."

Incidence. The incidence of heterotopic pancreatic tissue not only at necropsy but at operation was studied from reports in the literature and from our own findings in the surgical records and those of the Section on Pathologic Anatomy of the Mayo Clinic. It is seen that the incidence at necropsy varies

TABLE V—PRECISE HISTOLOGIC LOCATION OF THE HETEROTOPIC PANCREATIC TISSUE IN 26 CASES

Location	Symptoms	No. of symptoms	Total cases	Per cent
In submucosa only	9	8	14	54
In submucosa and infiltrating muscular fibers	5		6	23
Between muscle fibers only				8
On the subserosa or serosal surfaces only			3	11
In the submucosa between the muscle fibers and in the subserosal tissue				4
Total	15	8	26	100

from 0.6 per cent to 5.6 per cent of routine necropsies (Table IV). At operation heterotopic pancreatic tissue is found once in approximately every 500 operations in the upper abdominal region.

There is a higher incidence of surgical cases in the fourth, fifth, and sixth decades of life than in other decades but the anomaly has been found in patients of all ages both young and old, including infants and newly born. In our series the youngest patient was 4 months and the oldest patient was 64 years of age.

Location. We particularly endeavored to determine the usual and unusual locations of pancreatic heterotopias. The duodenum, stomach, and jejunum are the most common sites, with an incidence for the three sites of almost 70 per cent, 27.7 per cent for the duodenum, 25.5 per cent for the stomach, and 13.9 per cent for the jejunum (Table III). All the other unusual locations are mentioned in Table III.

Morphology. Heterotopic pancreatic tissue usually presents itself as a single firm and, when visible, yellowish (light yellow or cream color) or white, opaque, lobulated, round, or irregular node with granular surface. The maximal diameter of the node is usually 1 to 4 centimeters. Its appearance is like that of the pancreas itself or of a salivary gland. Larger masses may be found (Fig. 1).

The histologic picture of heterotopic pancreatic tissue is frequently the same as that of the pancreas itself, with acini forming lobules with ducts and islands of Langerhans (Fig.

TABLE VI.—SUMMARY OF 6 CASES* OF PANCREATIC HETEROTOPIA ASSOCIATED WITH GLYCEMIA AND HYPERINSULINISM, COLLECTED BY THE AUTHORS FROM THE LITERATURE

Case number and author	Patient, sex and age, years	Symptoms	Operative findings	Pathologic findings	
1. Vecchi 1914 (one case)		No clinical history. Hyperinsulinism?	Large tumor near tail of pancreas	Large islet cell tumor (malignant adenoma) arising in accessory pancreas	
2. Faala 1937 (one case)	Male 37	Hypoglycemia and hypochlorhydria	Removal of walnut sized nodule of aberrant pancreas in duodenum	Heterotopic pancreatic tissue, not adenomatous	P
3. Meyer Apr 1937 (one case)	Female 28	Hyperglycemia. Loss of weight. Abdominal tumor. Roentgenogram suggested tumor between stomach and colon—pancreatic cyst?	Cystic tumor in stomach wall with communication with pylorus with puritic ulcer. No communication with pancreas. Removal of tumor and pyloroplasty	Cystadenocarcinoma of aberrant intragastric pancreas (epitheliomatous masses with cells like Langerhans cells). Gastric ulceration	P
4. White and Gillies Aug., 1937 (one case)	Female 3	*Hypoglycemia. Fear episodes. Mental confusion, restlessness, headache, dizziness and trembling. No result with medical treatment	Removal of calcified tumor outside pancreas, in connective tissue surrounding it. No connection with pancreas	Calcified adenoma 11.5 cm with islet cell tissue. No mitotic figures	C
5. Bellenger Aug. 1941 (one case)	Male 33	*Very low hypoglycemia (proved specifically not to be hepatogenic). Fasting—mental confusion and lalanism, convulsions and coma (worse with metastases)	Tumor rosted cm. found in retroperitoneal area between upper border based of pancreas and apicalia lobe of liver. Induration of liver irre-movable. Biopsy	Metastasizing islet cell carcinoma of aberrant pancreatic tissue in liver containing hypoglycemia-producing substance	H p ti lar cor
6. Radd and Walton Oct., 1941 (one case)	Male 49	*Stupor—unconscious with low blood sugar level. Dramatic recovery with glucose (Parkinson's syndrome). Hypoglycemia	Nodule in gastroduodenal area 5 cm. from tip of tail of pancreas. Firm, rounded, 3 cm. in diameter. No connection with the main gland.	Islet adenoma (pink on cut surface)	Phys (a) si
7. Smith Feb. 1941 (one case)	Female 45	*Weakness—faint. Appetite for sweets. Hypoglycemia. Relief of symptoms with food	Excision of nodule from descending duodenum	Nodule 2x1x2x2 cm. Weight 1.5 gm. with acini, ducts and diffuse islet cells (not adenomatous)	N Gai
8. H Jan W d Stockton Aug. 1943 (one case)		Diabetes and weakness with inadequate feeding and thirst. Intermittent episodes of acute mental upset, irresponsiveness and coma. Hypoglycemia	At operation. Excision of black nodule near end of tail of pancreas, together with a portion of pancreas, and spleen. Excision of second black node between pancreas and spleen	At nodule: Islet cell adenoma, 7 cm in diameter and nodule: Islet cells; nodule cm in diameter	No fir Pat yr
9. H Jan W d Stockton Aug. 1943 (one case)	Female 6	Node found incidentally	Node in proximal duodenum found incidentally during necropsy following death from peritonitis	Sebaceous islet cell adenoma	Died

*This table also includes Vecchi's case, as well as one case of islet cell adenoma without hypoglycemia and one case of islet cell carcinoma with hypoglycemia, from the literature.

2) There may, however be a lack of one or another histologic element of the normal pancreas

In the majority of the cases reported as well as in our own cases the type of mucosa directly overlying the heterotopic tissue is the same as the type of mucosa normally corresponding to that particular portion of the gastrointestinal tract where the heterotopic pancreatic tissue is situated. We were not convinced of any direct relation continuity, or transition between the glands and ducts of the mucosal epithelium and the acini and ducts of the heterotopic pancreatic

tissue. The only possibility of indirect connection would be by means of the ex ducts of the heterotopic pancreatic emptying into the lumen of the intestinal tract through the ducts of the colal epithelium. The commonest location of heterotopic pancreatic tissue found to be the submucosa alone, incidence of 53.8 per cent. The second common type of involvement was between the longitudinal or circular fibers or both, with an incidence of 41 per cent. The least common location serosal surface (Table V)

TABLE VII.—PRODUCTION OF SYMPTOMS BY THE HETEROTOPIC PANCREATIC TISSUE, ACCORDING TO ITS LOCATION IN THE STOMACH, DUODENUM OR JEJUNUM IN 37 AUTHENTIC AND 37 UNCONFIRMED CASES FROM AUTHORS' SERIES OF PANCREATIC HETEROTOPIAS, IN WHICH THE FOREGOING LOCATIONS WERE FOUND

Location	With symptoms			Without symptoms			Total
	Authentic cases	Unconfirmed cases	Total	Authentic cases	Unconfirmed cases	Total	
Stomach*	9			4		4	13
Duodenum†	6		18	4	7		30
Jejunum‡				4	6		10
Total	15	14	29	12	13	25	64

*There was also one case of pancreatic tissue in gastric diverticulum (with symptoms).
 †There was also one case of pancreatic tissue in duodenum & jejunum (with symptoms).
 ‡There was also one case of pancreatic tissue in jejunal diverticulum (without symptoms).

Physiology. Special staining methods were utilized to determine whether or not heterotopic pancreatic tissue secretes enzymes. Mallory's (36,37) phosphotungstic acid hematoxylin stain was most satisfactory. Histologic evidence of acinar function in our cases was present in 76 per cent. In these cases, refractile zymogen granules could be seen in the apex or base of the acinar cells or scattered all over inside these cells (Fig. 3). An investigation was carried out in order to determine what influence this external secretion could have on the gastric acidity. As a result of the analysis of gastric contents in our cases, we cannot conclude that there is any significant deviation to indicate alkalization of the gastric acidity brought about definitely by functioning heterotopic pancreatic tissue in the stomach wall. We did not carry out a histologic study with any special staining

methods for types or functional activity of cells in the islands of Langerhans but we have no reason to disbelieve in the functional activity of the islets of normal appearance in heterotopic pancreatic tissue. We wonder whether heterotopic pancreatic tissue may not, to a certain extent, constitute a somewhat similar circumstance to a graft of a small fragment of pancreatic tissue.

It is of great practical importance, especially to the surgeon to note that hyperinsulinism and hypoglycemia have been observed associated with extrapancreatic, insulin-producing islet cell adenomas and adenocarcinomas (Table VI). If therefore exploration is being carried out in a case of hypoglycemia with definite "Whipple's essential triad" and after a thorough search, no tumor is found in the pancreas, the surgeon should look for heterotopic pancreatic

TABLE VIII.—FORTY THREE CASES OF PANCREATIC HETEROTOPIA COLLECTED FROM THE LITERATURE BY POPPI IN 1935 IN WHICH SYMPTOMS WERE PROVED AT OPERATION TO BE PRODUCED BY THE HETEROTOPIC PANCREATIC TISSUE

Clinical diagnosis and percentage	Location of heterotopic pancreatic tissue					Total
	Stomach	Duodenum	Jejunum	Gallbladder	Mechetti's diverticulum	
7 cases gastric or duodenal ulcer 30.23%	7					7*
10 cases gastropathy 23.26%	9					11†
7 cases cholelithiasis, hepatic colic or right upper quadrant syndrome 16.28%	3	3				7
9 cases pyloric stenosis 20.93%	9					9
Total	28	3				31

*Only the 30 cases in which no ulcer was found are included.

†In one case the location was both gastric and duodenal. These two notes account for the total number of 31 instead of 43 mentioned in the title of the table.



Fig. 1. Case 22, Table I. Mass of heterotopic pancreatic tissue removed from the mesentery of the transverse colon. Its dimensions were as follows: length 10 centimeters; width largest (globular end) 4.5 centimeters, smallest (neck) 3 centimeters; thickness, 3 centimeters. A cyst was found at the globular end of the elongated mass of heterotopic pancreatic tissue. The cyst contained stones (largest 4 mm.) and sandy material. Grossly at operation the mass gave the impression of a lymphosarcoma or of tuberculosis of lymph nodes.

tissue in its most common locations and also in such of the unusual sites as permit exploration.

Pathology. Pathologic changes have been found in heterotopic pancreatic tissue itself in the surrounding tissues or in both. Heterotopic pancreatic tissue presents the same pathologic changes as the pancreas, namely cysts, pancreatitis, hemorrhage, necrosis, and neoplastic change (benign and malignant). Data on 3 cases of cyst formation in heterotopic pancreatic tissue are presented in Table I (Fig. 4). An investigation was carried out to determine the presence of dilatation of the ducts in pancreatic dystopias. The ducts were

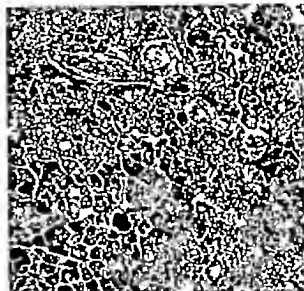


Fig. 2. Case 1, Table I. Portion of a mass of heterotopic pancreatic tissue measuring 3.5 by 3 by 1.5 centimeters on the posterior wall and lesser curvature of the stomach, showing acini and islands of Langerhans. Hematoxylin and eosin. $\times 88$.

found to be dilated in a large number of cases. Both benign and malignant changes in heterotopic pancreatic tissue have been observed. We feel that malignant change is more likely to take place in heterotopic pancreatic tissue than in the normally placed pancreas. The heterotopic pancreatic tissue is not always completely formed and differentiated. Both benign and malignant change would possibly be more likely to take place in an incompletely developed and less differentiated tissue in an aberrant location where it is subject to irritation than in a normal tissue in its usual site. There have been cases in the literature in which the malignant change had its origin traced back to heterotopic pancreatic tissue. It seems that there is little basis to believe in any connection between heterotopic pancreatic tissue and the histogenesis of carcinoids.

Pathologic changes sometimes occur in the tissues adjacent to the heterotopic pancreatic tissue, namely fat necrosis, inflammation, hemorrhage, ulceration, and diverticulum formation. All the foregoing pathologic changes were studied fully, especially ulceration of the mucosa overlying the dystopic pancreatic tissue, which may be the cause of gastroduodenal ulcers in a small number of cases. In such cases conservative surgical treatment



Fig. 3. Case Table I. Portion of a mass of heterotopic pancreatic tissue in the stomach wall. Staining method Mallory's phosphotungstic acid hematoxylin stain, with oil immersion lens. $\times 53$. The individual zymogen granules can be seen agglomerated at the apex of the acinar cells.



Fig. 4. Case 6, Table I. View from the serosal side of portion of gastric wall, measuring 7.5 centimeters in diameter (centered 1th cauterly) containing an intramural mass of heterotopic pancreatic tissue, measuring 3 by centimeters. Cysts can be seen grossly in the pancreatic tissue.

is indicated namely simple local excision of the ulcer together with the underlying misplaced pancreatic tissue mass. Data on 3 cases are presented in Table I. Formation of a diverticulum brought about by heterotopic pancreatic tissue was studied; data on 3 cases in which symptoms were caused by these lesions will be found in Table I.

Clinical significance. In 25 (61 per cent) of the 41 authentic cases of pancreatic heterotopia the heterotopic pancreatic tissue was proved at operation to have been the only



Fig. 5. Case Table I. Mass of heterotopic pancreatic tissue measuring 3.5 by 3 by .5 centimeters on the lesser curvature and posterior wall of the stomach giving a roentgenologic image of an ovoid mass in midportion of stomach; its malignant nature could not be excluded roentgenologically.

lesion, the principal lesion or at least one of the lesions causative of symptoms for which the patient was submitted to surgical intervention. Of the 25 authentic cases in which there were symptoms, it was seen that in 9 (36 per cent) the heterotopic pancreatic tissue was located in the gastric wall. The incidence in this location in all authentic cases, with or without symptoms was 31.7 per cent. In 6 (24 per cent) of the cases in which there were symptoms the location was in the duodenal wall. The incidence in this location in all authentic cases was 24.4 per cent. There were no cases with jejunal location presenting symptoms but the incidence in this location in the authentic cases without symptoms was approximately 10 per cent (Tables VII and VIII). For the cases in which heterotopic pancreatic tissue occurred in other locations see Table III. In most of the cases of pancreatic heterotopia in which there were symptoms, the location was either gastric or duodenal. Proportionately the cases of heterotopia with gastric location contribute more than the ones with duodenal location to the number of cases with symptoms. In 13 cases reviewed there was persistence of symptoms possibly because of failure to remove a supposed pancreatic heterotopia at operation.

Symptomatology. There is no single symptom complex for pancreatic heterotopia. The symptoms, of course vary according to the



Fig. 6. Case 1 Table I Mass of heterotopic pancreatic tissue measuring 3.5 by 3 by 1.5 centimeters on the lesser curvature and posterior wall of the stomach. The patient gave a history simulating that of duodenal ulcer and a loss of weight. The tumor was mistaken clinically roentgenologically and at operation for an adenocarcinoma of the stomach. The tumor had been sectioned for examination when this picture was taken.



Fig. 7. Case 1 Table I Heterotopic pancreatic tissue mass, showing pancreatic tissue extending between the muscular bundles. Grossly the tumor seemed to infiltrate the muscular coat of the stomach. Hematoxylin and eosin. $\times 70$.

which were caused by the heterotopic pancreatic tissue as proved by the relief of symptoms after its removal in practically all the cases. Data on 3 cases are presented in Table I (Fig. 10).

Among our 10 cases of pancreatic heterotopia with a gastric location there was 1 case in which pyloric obstruction was observed

different locations in which heterotopic pancreatic tissue may be found. The symptoms produced however are generally similar to those produced by gastroduodenal lesions namely symptoms of gastric ulcer duodenal ulcer pyloric obstruction cholecystitis obstruction of the common duct, chronic or acute appendicitis or indeterminate digestive symptoms. The group of authentic cases in which there were symptoms was reviewed in subgroups divided according to location and the complication or disturbance that the anomaly caused. There were 10 authentic cases of pancreatic heterotopia with a gastric location and presenting symptoms which were caused by the heterotopic pancreatic tissue as proved by the relief of the symptoms after its removal. Data on 6 cases are presented in Table I (Figs. 5, 6, 7, 8 and 9). There were 7 authentic cases of pancreatic heterotopia with duodenal location and presenting symptoms



Fig. 8. Case 2 Table I Gastric nodule of heterotopic pancreatic tissue 1.5 centimeters in diameter producing a filling defect near the greater curvature just proximal to the pylorus. It appeared like a leiomyoma grossly at operation.



Fig. 9. Case 7. Table I. Nodule of heterotopic pancreatic tissue measuring 8 millimeters in diameter in the submucosa of the posterior wall of the prepyloric region of the stomach. The overlying gastric mucosa is pitted.



Fig. 10. Case 5. Table I. Nodule of heterotopic pancreatic tissue measuring 1.5 by 0.8 centimeter in the anterior wall of duodenum immediately below pylorus. The mass looked like fibroma grossly before operation.

Data on this case are presented in Table I (Figs. 11 and 12). Seventeen cases of pyloric stenosis which were secondary to the presence of heterotopic pancreatic tissue were collected by Krieg from the medical literature in 1939 and published in 1941. We found in the literature 5 additional cases of heterotopic pancreatic tissue causing pyloric obstruction from the time of Krieg's review in 1939 up until March, 1944. Krieg mentioned a group of 23 cases of Poppl's series which he interpreted as having been produced by local spasm of the intestinal wall. In his opinion the difference between the cases of stenosis and those of spasm is that of time and the degree of irritation.

Hypertrophy of the muscular coat was evidenced grossly and microscopically in 11 out of 19 authentic cases of our series of pancreatic heterotopia in the gastrointestinal tract. In our series of authentic cases, there were 2 cases of Meckel's diverticulum containing heterotopic pancreatic tissue. Data on

a case of ileal intussusception brought about by an ileal diverticulum containing pancreatic tissue will be found in Table I. Data on a case of pancreatic heterotopia in the wall of the gallbladder are presented. This case is of interest in the light of Colp and Doubilet's studies on the clinical significance of pancreatic reflux. Data on a case of obstruction of the common duct caused by heterotopic pancreatic tissue are presented in Table I. The possibility of duodenal adenocarcinoma arising in dystopic pancreatic tissue in the ampulla of Vater and in the papilla of Santorini is suggested. A study of the pathogenesis of the disturbances and symptoms caused by heterotopic pancreatic tissue was made. The pathologic changes have an influence on the production of symptoms.

Diagnosis. The clinical, the roentgenologic, the operative and the pathologic diagnosis of pancreatic heterotopia were reviewed. Of the cases in which the heterotopic tissue was in a gastric location the diagnosis of a benign



Fig 11. Case 8, Table I. Annular mass of heterotopic pancreatic tissue on the serosal surface of the pyloric ring. The roentgenologic report was as follows: "Annular lesion involving pylorus, prepyloric area and base of duodenum; shallow ulceration impossible to exclude malignancy."

tumor was made in 50 per cent of ulcer in 20 per cent, and of malignant tumor in 20 per cent. The mass was missed in 10 per cent. In only 1 of the cases in which the location was duodenal was the diagnosis of duodenal tumor made. In all the others the roentgenologic diagnosis of duodenal ulcer was made although in only 1 was an ulcer actually present. The preciseness of the roentgenologist's diagnosis of gastric polyps may be seen from his reports in 6 of our cases in which the masses were of relatively minute proportions. The diagnosis of a gastric or duodenal polyp is the nearest that one can actually get to the precise and final diagnosis made by the pathologist, although in 3 cases of our series the exact nature of the mass was suspected. Apparently analysis of gastric contents is of no avail in determining possible alkalinity or reduced acidity of gastric contents due to alkalization of the gastric juice from pancreatic secretion flowing from heterotopic pancreatic tissue although this possibility should be kept in mind. Gastroscopy might



Fig 12. Case 8, Table I. Specimen 12 centimeters of stomach and 1.5 centimeters of duodenum. Heterotopic pancreatic tissue forming an annular mass, 3 centimeters in diameter on the serosal surface of the pyloric ring. The tumor in the picture is included between the points of the two arrows. It was causing pyloric obstruction and loss of weight clinically, roentgenologically and grossly at operation it was mistaken for an adenocarcinoma of the stomach.

possibly be an aid in the diagnosis by confirming the roentgenologic finding or by revealing the tumor to be intramural, covered by normal mucosa and not ulcerated as in gastric carcinoma. When visible on the serosal surface a pancreatic heterotopia is grossly recognizable but there should always be a confirmative diagnosis by the pathologist. In 18 surgical cases of pancreatic heterotopia in which a notation was made of the surgeon's impression from gross examination we reviewed the operative diagnosis made prior to the pathologist's report. In approximately 29 per cent the pancreatic heterotopia gave the impression of a malignant lesion. In 50 per cent the diagnosis of a benign lesion was made. In a little more than 22 per cent the nature of the mass was recognized correctly as being

TABLE IX.—SURGICAL PROCEDURES PERFORMED IN 25 CASES OF PANCREATIC HETEROTOPIA

Surgical procedure	Cases
Biopsy	1
Partial gastrectomy	0
Removal of tumor	10*
Resection of gangrenous bowel (Intussusception)	1
Cholecystectomy	2†
Diverticulectomy and appendectomy	
Total	5

*Resection of an associated pancreatic cyst, as performed in case cholecystectomy and exploration of the lumen of gallbladder case and in case transduodenal removal of duodenal adenocarcinoma and cholecystectomy.

†Exploration of the common duct was performed in case.

heterotopic pancreatic tissue. The pathologist's diagnosis based on examination of frozen sections at the time of operation is essential. The correct diagnosis was promptly made in practically all the cases.

Surgical treatment. There are two circumstances in which a pancreatic heterotopia may be found at exploration: it is either causative of symptoms or it is only an incidental finding. In Table IX we listed the operative procedures performed in 25 cases of our series of pancreatic heterotopia that were clinically significant. In no case was persistence or recurrence of symptoms observed following the complete radical or conservative removal of the pancreatic heterotopia when this lesion was the only cause of the complication and referred symptoms. In some of the cases of our series a more conservative operative procedure rather than gastrectomy could have been performed probably with equally good final results had it been possible for the surgeon to know that he was dealing with a benign lesion. In only 1 case in our series did a patient die from a complication associated with a pancreatic heterotopia, namely ileal intussusception.

When the pancreatic heterotopia is located in the stomach or duodenum simple local excision when feasible is sufficient to bring about relief of symptoms. At times careful duodenal reconstruction or pyloroplasty may have to be carried out. Since as is shown by the abstracts of the case records, in most instances a roentgenologic diagnosis of ulcer, tumor, carcinoma, or polyp was made preoperatively it is understandable why in 10 instances partial gastrectomy was chosen by the surgeon as the procedure to be performed.

It would be difficult to tell by palpation the nature of the lesion and biopsy of gastric lesions is at best frequently indeterminate. Therefore by and large with carcinoma so common in the stomach and pancreatic heterotopia so uncommon it would be to the patient's best interest to elect gastric resection. Frequently one of the modifications of the Billroth I operation would be possible and indicated when the lesion is found in the lower third of the stomach. In higher lesions a Polya operation or one of its modifications would be suitable.

In the presence of a diverticulum associated with heterotopic pancreatic tissue removal of the diverticulum together with the heterotopic tissue is indicated with simple local excision alone or possibly with pyloroplasty or duodenal reconstruction. In the presence of muscular hypertrophy possibly associated with pyloric stenosis, excision and pyloroplasty are indicated.

Whenever pathologic changes are encountered in other organs with the presence of a pancreatic heterotopia and the former seem to have more to do with the patient's symptoms than the latter the surgeon should not underestimate the potentiality for production of symptoms or actual present clinical significance of the pancreatic heterotopia, complete removal of which should be carried out. The operative procedure advised for pancreatic heterotopia in locations other than the stomach and duodenum is complete but simple extirpation but no generalizations can be made so varied are the locations. One has to depend on one's surgical judgment in the particular case. As far as the pancreatic heterotopia is concerned one can be as conservative as possible. In several of our surgical cases of clinically significant pancreatic heterotopia operation had been performed for some other condition prior to admission of the patient to the Mayo Clinic and at a time when the heterotopic pancreatic tissue was not clinically significant. If the heterotopic tissue had been removed at this time the later operation for its removal could have been avoided. Whenever heterotopic pancreatic tissue is found in the stomach or duodenum incidentally during the course of an operation

for some other surgical lesion its excision is indicated to avoid future trouble unless the risk of the procedure outweighs the advantages of removal. A jejunal pancreatic heterotopia found incidentally during the course of an operation for some other condition may be left undisturbed with a fair chance that no complications will be observed subsequently unless such pathologic changes are present that there is a question as to either its present or its future clinical significance. The same general rule as the aforementioned one would hold true for pancreatic heterotopia in other locations although surgical judgment for the particular location varies.

SUMMARY AND CONCLUSIONS

There are approximately 470 recorded cases of pancreatic heterotopia. Pancreatic heterotopia is observed fairly frequently at routine necropsies. We found an incidence of 1 case of pancreatic heterotopia in approximately every 500 operations in the upper abdominal region. The incidence of pancreatic heterotopia is highest in the fourth, fifth and sixth decades of life.

The ratio of males to females is almost 3 to 1. The most common location is in the stomach, duodenum and jejunum where the incidence is almost 70 per cent. In the majority of the cases the mass of heterotopic pancreatic tissue is single and its diameter usually varies from 1 to 4 centimeters.

The histologic picture of heterotopic pancreatic tissue is frequently the same as that of the pancreas itself. The commonest histologic location of heterotopic pancreatic tissue in our series was the submucosa alone. There frequently is intermuscular infiltration. In the vast majority of the cases there is histologic evidence of acinar function. There is no apparent change in the results of analysis of gastric contents associated with a pancreatic heterotopia.

Hypoglycemia and hyperinsulinism have been observed in association with heterotopic pancreatic tissue presenting both benign and malignant change in its insular portion. If exploration is being carried out in a case of hypoglycemia with definite Whipple's essential triad and after a thorough search no

tumor is found in the pancreas the surgeon should search for heterotopic pancreatic tissue in its most common locations and also in the unusual sites that are capable of exploration. Both adenomas and adenocarcinomas of islet cell type may be present without clinical evidence of hypoglycemia.

Heterotopic pancreatic tissue presents the same pathologic changes as the pancreas itself. In many cases the ducts are found dilated. Malignant change is more likely to take place in heterotopic pancreatic tissue than in the pancreas proper. Pancreatic heterotopia may be the cause of several types of pathologic changes in the adjacent tissues, namely fat necrosis, inflammation, ulceration, hemorrhage, necrosis and formation of a diverticulum.

In a high percentage of surgical cases of pancreatic heterotopia (61 per cent of our cases) the heterotopia is found to be of clinical significance. The location is usually gastric or duodenal. Some of the rare adenocarcinomas of the duodenum may have had their origin in heterotopic pancreatic tissue either in the ampulla of Vater or in the papilla of Santorini. The syndromes presented by a pancreatic heterotopia are generally those of gastric or duodenal ulceration, cholecystic disease or indeterminate digestive symptoms.

The pathologic diagnosis with frozen section technique at the time of operation is of inestimable value. A mass of heterotopic pancreatic tissue can be mistaken for a malignant growth both roentgenologically and at operation with a consequent unnecessary operation. When the pancreatic heterotopia is clinically significant its simple excision when feasible is entirely sufficient for complete relief of symptoms. When found incidentally at operation its removal is indicated in the majority of cases.

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SECONDARY SUTURE OF WAR WOUNDS

A Study of Methods and Results in an Overseas General Hospital

KNOWLES B LAWRENCE, M.D., F.A.C.S., and SOMERS H STURGIS M.D. F.A.C.S.
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THE success of the U S Army Medical Corps policy of early débridement of wounds without primary suture in preventing serious infection was demonstrated repeatedly during World War II. It was equally well known that secondary healing of such débrided wounds by granulation and epithelization often consumed several months. Painful and disabling cicatrices, osteomyelitis, stiff joints and muscle atrophy were frequent complications of wounds allowed to heal by second intention. Psychoneurosis developed or aggravated during long hospitalization rendered many soldiers unfit for further combat duty. For the first 2 years after Pearl Harbor the tremendous wastes in man power and in hospital care resulting from such a slow healing were serious hindrances to the war effort.

The obvious answer to these problems was to effect closure of débrided wounds as early as consistent with safety. In World War I primary suture was practiced sometimes on selected wounds not more than 12 hours old (5). The percentage of successful healing in several series of primarily sutured wounds including a few joint wounds was excellent (from 66 to 94 per cent) but there was also a significant mortality rate. It was concluded as a result of those experiences that the use of the primary suture after débridement should be restricted to quiet periods in the fighting when the wounded patient could be kept in one hospital until healing was assured. The decision to close the rest depended largely on the reports from routine culture and smear taken at the daily dressing. Delayed primary suturing of wounds free from hemolytic streptococci, within the first 5 days was distinguished from the 'secondary suture' of all later closures in which inversion of skin edges and a granula-

ting base had developed. In both delayed primary and secondary closures a miscellaneous assortment of antiseptics had been previously applied to combat the nearly omnipresent infection. Reported results in small series of cases varied from 66 to 88 per cent of 'success' (1-5). In general the methods of early closure of wounds during World War I seemed either too narrow in selection of cases or too cumbersome in practice to be applicable to large numbers of wounds encountered under average conditions of combat.

Experiences reported from the Republican army in the Spanish Civil War obscured the issue in a sense for, there emphasis was placed on the plaster encasement treatment of serious extremity wounds (7). The primary missions of reducing fatality rates and obtaining reasonable healing of fractures despite unfavorable tactical situations were accomplished by this treatment. That better and more rapid healing might be obtained by early closures of such wounds in communication zone hospitals and with the help of modern chemotherapeutic agents was not envisaged at that time.

The use of chemotherapy in conjunction with radical débridement in World War II seemed to change the pathology of war wounds. The majority remained grossly as clean as any other surgical wounds, if infection was not introduced by changing the dressing at least for a week or 10 days following débridement. In overseas base hospitals surgeons guided by this finding tried secondarily suturing these wounds during this initial period when they were 'clean'. By 1944 this procedure was being performed routinely during the first 10 days after débridement in many U S Army hospitals of the Mediterranean Theater.¹ Results were gratifyingly good. In June 1944 Kirtley and Trabue reported 92.7 per cent

¹Formerly members of the Surgical Service, 6th General Hospital, U S Army.

²See Circular letter No. 16, The Surgeon, North African Theater of Operations, United States Army April 19 1944.

successful healing in one group of 217 'delayed primary' sutures, and only 3 infected wounds in another group of 30 cases studied in detail. In the latter group 71 individual wounds were sutured 4 to 5 days after wounding. Wilson obtained healing without infection in 85 per cent of 224 wounds secondarily sutured when less than 10 days old. In wounds sutured after 10 days the primary healing rate was reduced to 38 per cent. Wilson's study was based on 305 total wounds in 209 patients. The results in both series are colored somewhat by the fact that compound fracture cases apparently were not included.

The work of British surgeons on this important subject as reported to the Congress of Central Mediterranean Force Army Surgeons, Rome Italy February 1945 is of special interest. After a somewhat longer period of participation in the war the British were fully aware of the advantages of early closure of wounds. Their efforts as described at that meeting were being directed toward the improvement of results in such wound handling chiefly by the local use of chemotherapeutic agents. Murray reported that 91 per cent of 500 fresh wounds treated locally with a penicillin powder at time of suture healed successfully after delayed primary suture¹ in contrast to 75 per cent successful healing in 229 proflavine treated wounds. In a paper entitled 'Early Closure of Compound Fractures' at the same congress Hendry reported 60 per cent of his cases with complete healing of the skin over major fractures of long bones within 6 weeks after delayed primary suture.

Secondary closure was performed on the wounds of approximately 2200 patients at the 6th General Hospital situated near Rome, Italy during July, August, and September of 1944. The present report is based chiefly on a series of 1110 of these patients with more than 2700 individual wounds. Most of the balance consisted of a number of patients operated upon during this period which could not be included solely because the press of work at times made it impossible to obtain and record the necessary data. At least 100 patients were evacuated to the rear to create bed space before healing results could be evaluated. (ulte

¹Synonymous with our term "secondary suture."

a few cases, in which wounds were limited to amputations or to wounds of the fingers, toes or face were excluded also because they represented a different sort of surgical problem. Aside from these specific omissions the series was unselected and included various types of soft tissue wounds as well as those associated with compound fractures. Thirty different surgeons operating on these patients used their own judgment in carrying out the details of the general policy.

GENERAL POLICY

A great influx of recent casualties arriving from forward hospitals with wounds already debrided made necessary the adoption of mass production methods of surgical management. This consisted principally of a systematic performance of secondary suturing in the early clean period within a week or 10 days after débridement.

Guided by our own previous experience and reports from other hospitals, it was the policy to leave the dressings unchanged until the patient's arrival in the operating room. However a few wounds required preoperative inspection because of unexplained fever, pain, excessive drainage or hemorrhage. In general this method represented a vast saving in time, materials and discomfort to the patient over the daily dressing regimen of World War I. Many patients received sulfadiazine by mouth, and this was often continued for several days after operation. The use of penicillin parenterally was not routine and was usually restricted to severe compound fracture wounds into joints, and grossly infected wounds. Transfusions of blood and plasma, vitamins and other supportive treatment were used as indicated. Most surgeons preferred a time interval of at least 48 hours between admission and secondary suture to allow for rest and observation.

In the group of cases here studied 96 per cent were admitted to this hospital in time to be scheduled for secondary closure before the tenth day following their débridement. Occasionally secondary closure was contraindicated by the condition of the patient or his wound. It was soon noted that the clinical appearance of the wound on the fifth or sixth day after

débridement suggested that this was the most favorable time for suturing.

On first inspection of these wounds in the operating room we were surprised at the small percentage which seemed unsuitable for closure because of gross signs of necrosis. In a series of over 300 wounds personally observed by the authors, this was less than 5 per cent, and testified to the excellent results from débridement and chemotherapy usually penicillin at forward hospitals. Culturing of wounds for determination of bacterial flora was impractical as a routine procedure.¹ Wounds containing thin purulent exudate, with, at times slight reddening of skin at margins and turgidity of tissues proved to be trouble makers. Such wounds were very apt to become septic and break down if sutured in that condition and did much better after preliminary treatment for 24 hours or more with wet dressings of which the most effective seemed to be penicillin solution (500 or 1000 units to 1 c.c.) Patches of fibrin adherent to otherwise fairly dry and innocent looking wounds usually did not deter healing. A number of wounds, though clean were of such a large size or so located that they could not be closed completely by secondary suturing. In some the unsutured part was left to heal spontaneously. In others this area was covered with a split thickness skin graft immediately or at a later date. The longest wound measured 70 centimeters extending from the lateral aspect of the hip to the knee. It healed satisfactorily after secondary suturing. The greatest number of wounds in one patient was one hundred.

TECHNICAL ASPECTS OF SECONDARY SUTURING

Anesthesia Intravenous sodium pentothal was the most commonly used anesthetic agent. There were no deaths attributable to pentothal in this series. Novocain locally was used in about one quarter of the cases. Infiltration of subcutaneous tissue from the wound surface seemed simpler and caused less discomfort to the patient than block anesthesia through the intact skin.

¹The wisdom of this decision to omit routine wound cultures was confirmed later by the work of Beatty and Thomson who found that only 20 per cent of series of 64 grossly clean wounds contained pathogenic bacteria and that satisfactory healing was obtained after secondary suturing in 6 per cent of even these "infected" wounds.

Surgical technique Accurate approximation of the entire depth of the wound without excessive tension was the primary objective of the operation. It was felt that the less cutting or surgical manipulation of any kind the less risk there would be of breaking through the natural defenses against infection that had been mobilized about the wound edges in the preceding days. Wounds more than a week old, however generally require freshening or freeing up of the margins to obtain apposition of the skin edges without inversion. Wounds over large muscle bellies, as in the thigh, but tocks, or arm, often presented a problem in closure unique to war injuries. The swelling of injured muscles at times produces wide retraction of wound margins. Where there is no significant skin loss the degree of tension required to close these wounds accurately reflects the amount of edema to be reduced. Therefore, marked tension in the closure of these particular wounds is not only tolerated but proportionately necessary to relieve lymphostasis and congestion and undermining the edges to avoid this tension in such wounds is undesirable. Where there was major skin loss extensive undercutting was resorted to without hesitation in order to close the wound. Advancement and rotation of contiguous skin flaps occasionally permitted closure of wounds in which even wide undermining did not accomplish this result. Due to experience with flexion deformities and recurrent breakdown of scars which were situated vertically over joints, particularly in the popliteal space we utilized these maneuvers to obtain more nearly transversely placed suture lines in such areas. Black silk was the most commonly used suture material, employed sometimes in conjunction with silkworm gut. The latter seemed to cause less tissue reaction and cutting through when under tension. The deep fascia was approximated as a separate layer in a few cases. Several instances of postoperative wound infection were seen with extrusion of nonabsorbable sutures however, and therefore buried sutures were avoided as a general policy. If the edges of aponeurosis or fascia are included in the deep bites of vertical mattress sutures, solid healing will be obtained in most cases. Of the few postoperative mus-

successful healing in one group of 217 delayed primary sutures, and only 3 infected wounds in another group of 30 cases studied in detail. In the latter group 71 individual wounds were sutured 4 to 5 days after wounding. Wilson obtained healing without infection in 85 per cent of 224 wounds secondarily sutured when less than 10 days old. In wounds sutured after 10 days the primary healing rate was reduced to 38 per cent. Wilson's study was based on 305 total wounds in 209 patients. The results in both series are colored somewhat by the fact that compound fracture cases apparently were not included.

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¹The authors of this document do not provide wound cultures was confirmed later by the work of Berth and Thomson who found that only 30 per cent of a series of 6 severely torn wounds contained pathogenic bacteria. 1 that satisfactory healing was obtained. 27 secondary suturing in 8 per cent of even these in closed wounds.

Surgical technique. Accurate approximation of the entire depth of the wound without excessive tension was the primary objective of the operation. It was felt that the less cutting or surgical manipulation of any kind the less risk there would be of breaking through the natural defenses against infection that had been mobilized about the wound edges in the preceding days. Wounds more than a week old however, generally require freshening or freeing up of the margins to obtain apposition of the skin edges without inversion. Wounds over large muscle bellies as in the thigh but of the arm, often presented a problem in closure unique to war injuries. The swelling of injured muscles at times produces wide retraction of wound margins. Where there is no significant skin loss the degree of tension required to close these wounds accurately reflects the amount of edema to be reduced. Therefore marked tension in the closure of these particular wounds is not only tolerated but proportionately necessary to relieve lymphostasis and congestion and undermining the edges to avoid this tension in such wounds is undesirable. Where there was major skin loss extensive undercutting was resorted to without hesitation in order to close the wound. Advancement and rotation of contiguous skin flaps occasionally permitted closure of wounds in which even wide undermining did not accomplish this result. Due to experience with flexion deformities and recurrent breakdown of scars which were situated vertically over joints particularly in the popliteal space we utilized these maneuvers to obtain more nearly transversely placed suture lines in such areas. Black silk was the most commonly used suture material employed some times in conjunction with silk worm gut. The latter seemed to cause less tissue reaction and cutting through when under tension. The deep fascia was approximated as a separate layer in a few cases. Several instances of post-operative wound infection were seen with extrusion of nonabsorbable sutures however, and therefore buried sutures were avoided as a general policy. If the edges of aponeurosis or fascia are included in the deep bites of vertical mattress sutures solid healing will be obtained in most cases. Of the few postoperative mus-

cle hernias observed only an occasional one has been symptomatic.

At first many deep wounds were drained at the time of secondary suture because of potential dead space retained blood clot or border line infection. With more experience this was found rarely necessary except in cases of compound fractures of the larger bones. Dependent stab wound drainage employing soft Penrose tubing was found preferable to draining through the suture line. The drains usually were removed within 1 to 4 days.

The wound surfaces were dusted with sul fanilamide powder in some cases but only one of the surgeons felt this was sufficiently valuable to employ it routinely.

Casts or plaster splints were applied in many of the extremity wounds involving soft tissues only. After observing the breakdown of several of the unsplinted wounds near joints we were convinced that this should be practiced more widely.

POSTOPERATIVE MANAGEMENT

It appears to be necessary to retain stitches in a secondarily sutured wound longer than is usually necessary in a primarily sutured wound. In the absence of infection the stitches were generally removed in from 10 to 14 days.

Mobilization of joints and muscle training were practiced as early as tissue reaction permitted in many cases even before wounds were completely healed. Experience showed that wounds of the lower extremities, however healed far more promptly if patients were kept off their feet until healing was complete.

RESULTS

Percentage of healing For purposes of detailed study the healing of these wounds was classified as primary delayed primary or secondary. The meaning of primary healing is obvious. In certain wounds localized eversion of skin edges mild stitch reaction persistence of the drain sinus or delayed healing where cruciate incision corners had been brought together did not represent perfect primary healing. The end result though delayed a few days hardly differed from that in primary healing however. We called this "delayed primary" healing. Primary and

delayed primary healing together constituted satisfactory healing. When definite infection and separation or breakdown of the suture line occurred the result was called unsatisfactory. In so far as value of the operation of secondary suture was concerned¹

Calculated on the above basis the overall healing results in the series were as follows. For 1110 cases the healing was either primary or delayed primary (and therefore satisfactory) in 937 or 84.4 per cent. In 173 or 15.6 per cent the healing was unsatisfactory. In an unselected group of about half the cases (605 cases) the effect of an associated compound fracture was noted. Serious compound fractures were present in 110 of these. There were incomplete or chip fractures in 30 other cases. In 85 or 77.3 per cent of the 110 major fractures, the secondary closures healed satisfactorily. Although lower than the "satisfactory" percentage for the total we feel this is an acceptable showing for the large and complicated wounds of this type. Twenty three of these involved humerus or femur. 18 of the compound wounds healed satisfactorily. In this small group and only 5 were unsatisfactory. There were no cases of infection or gangrene leading to amputation attributable solely to the closure of the wound and no deaths. Secondary suturing of wounds complicated by compound fractures, then was found to be a safe and justifiable procedure.

Optimum time for secondary suture Table I shows the ratio of satisfactory to unsatisfactory healing after secondary suture by days from date of wounding. The ratio of virtually 10:1 for cases operated upon the 6th day after wounding is the best showing for any of the larger groups. After the 6th day the ratio becomes definitely less favorable. Since the delay in debridement of the wounds averaged nearly 24 hours, the choice of 5 days as the optimum time from debridement to secondary suture appears to be vindicated statistically in this series of cases.

Choice of anesthesia in secondary suture Local anesthesia was used in 243 cases with satisfactory healing in 215 or 88.4 per cent unsatisfactory in 28 or 11.6 per cent. General

¹In all the tables in this report, the figures refer to cases and not to individual wounds. Where there were multiple wounds, if only one broke down, the case was labeled "satisfactory."

anesthesia was used in 867 cases with satisfactory results in 722 or 83.3 per cent unsatisfactory in 145 or 16.7 per cent. Local novocain was used generally in the smaller wounds and only where there was no obvious sepsis. Keeping this method of selection in mind it is clear that in this series the use of infiltration anesthesia did not increase the postoperative rate of infection or adversely affect the percentage of satisfactory healing. We know of no instance of significant wound infection attributable solely to the use of local anesthesia in the closure.

Disposition. The figures for disposition after secondary suture in this hospital were available for 1204 patients as follows. There was a salvage rate of approximately 72 per cent of the men for General Service within an average time of only 6 weeks after wounding. The disposition of a great majority of the 18.1 per cent discharged for evacuation to the Zone of the Interior (United States) was determined by the presence of fractures, nerve injuries, amputations or other conditions not directly affecting the healing of their wounds. A higher percentage of the Limited Service cases were so reclassified chiefly because of wound disability but other conditions or complications also dictated this disposition in many cases.

OBSERVATIONS

We feel that the healing results obtained in this large series of war wounds can be improved with more experience. Limitations as well as possibilities of secondary suture have been learned. Some of the older or slightly infected wounds might have healed better after application of hot compresses or antiseptic dressings for a few days before suturing. The more experienced use of the various plastic surgical maneuvers to obtain approximation of skin edges without tension, more thorough splinting of wounds near joints, and enforced bed rest during healing of leg wounds all should increase the percentage of satisfactory results. As noted above (2) British Army surgeons found that the local application of penicillin to the wounds increased their ratio of successful healing after secondary suture. They did not have a comparable series of wound cases with systemic penicillin treatment but showed

TABLE I—HEALING RESULTS BY DAYS FROM WOUNDING TO SECONDARY SUTURE—FIFTY CASES

Interval in days	Total cases	Satisfactory	Unsatisfactory	Ratio	
				Satisf.	Unsatisf.
3	8	18			
4	9	80	11	8.8	
5	74	55	9	8.0	
6	128	6	22	9.8	1
7	200	73	7	6.4	
8	165	13	3	4	1
9	70	58		7	
10	37	84	13	8	
11	55	3	4	7.7	1
		8	4	4.3	
12	12	8	2	5	
14	1	7	5	4	
5 or more	13	28		2.8	

that wound infection sometimes developed despite intramuscular penicillin in usual doses. Further reports may clarify this subject.

Secondary suturing may be applied in peace-time traumatic surgery. The majority of such wounds, whether due to vehicle and industrial accidents or injury by firearms, explosives or other means, will prove amenable to immediate primary suture after thorough débridement. In the light of present knowledge, the administration of penicillin systemically would be indicated in all but minor wounds. A few wounds with excessive contamination, marked tissue destruction or prolonged time lag between injury and treatment will be more safely handled, however, by delayed suture. We would suggest culturing a wound of this type at the time of débridement. Sulfanilamide or penicillin¹ could be applied topically if the surgeon desired and an occlusive dressing applied. The first change of this dressing should be made in the operating room on the fourth or fifth day. If the wound appeared grossly clean and the first culture had grown no hemolytic streptococcus, secondary suture would be indicated at that time. If however the wound appeared septic

¹Some British Army surgeons favor penicillin-sulfathiazole powder for this use and treat the wound surface thoroughly.

or the culture revealed hemolytic streptococcus suture should be deferred for at least 2 days. Wet dressings perhaps with penicillin solution, should then be applied frequently until the wound becomes sufficiently clean to tolerate suturing. Such a routine should result in satisfactory healing in a very high percentage of cases.

SUMMARY

The results of secondary suturing of a series of wounds at an overseas General Hospital during World War II have been analyzed.

In 937 84.4 per cent, of 1110 cases, satisfactory healing was obtained as a result of this procedure.

It was found to be safe and generally satisfactory to suture secondarily those wounds associated with compound fractures.

Details of technique and management related to secondary suture are discussed.

It was possible to return 71.9 per cent of the men to general service 10.0 per cent were reclassified to limited service and 18.1 per cent were discharged from this hospital for evacuation to the Zone of Interior.

The application of this method of handling to certain peacetime wounds is recommended.

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POSTCAVAL URETER, WITH DESCRIPTION OF A NEW OPERATION FOR ITS CORRECTION

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THE location of the right ureter behind the vena cava instead of overlying it, is a very rare anomaly, only 33 cases having been reported in medical literature to date. Even rarer is corrective surgical treatment of the condition only 4 such attempts having been reported previous to the one presented here.¹

In the present case a new operation was utilized which appears to have merit. It will therefore be described in detail.

REVIEW OF THE LITERATURE

Hochstetter, in 1892, was the first to describe a case of postcaval ureter in man this was in an infant a few weeks old and was discovered during routine dissection.

Pick and Anson tabulated 28 cases up to 1940 including one of their own. Five more have been added since one each by Harbach (1940) Harrill (1941) DeCarlo (1941) Gruenwald and Surks (1943) and Wilson and Herzlich (1944). The author's case makes the thirty fourth to be reported.²

Of these 34 cases 22 were diagnosed at post mortem examination or laboratory dissection 11 (including ours) at operation, and only 1 before operation.

All but 3 of the 34 patients were adults. Of these 3 cases, all discovered at routine dissection, one was in a stillborn infant, another in an infant a few weeks old and the third in a year old child.

Twenty five were males 7 were females and in 2 cases the sex was not given. It has

been suggested that the fact that males outnumber females by more than 3 to 1 in the reported cases may be accounted for by the greater number of male bodies that come to the dissection room and the postmortem table (where a majority of these cases were discovered). Of the 11 patients operated upon 7 were males and 4 females. Although a small group, this would seem to bear out the belief that the anomaly is more common in males.

Postcaval ureter may take several forms. The most common form is unilateral persistence of the posterior cardinal vein (observed on the right side only) the postrenal segment of this vein forming the postcava. Most of the reported cases are of this type. In 5 cases (Rotter Uebelhoefer Adachi 2, and Harrill) there was double postrenal vena cava, one on the right and one on the left side the ureter passing behind the corresponding vein. In only 1 case (Gladstone 1905) was there bilateral involvement. This case a stillborn acardiac infant, showed bilateral postcaval ureters (double postrenal vena cava, one on each side of the aorta with each ureter passing behind its respective vein).

EMBRYOLOGICAL CONSIDERATIONS

Present day opinion unanimously ascribes the anomaly to the embryonic vascular system rather than the urinary. Faulty development of the inferior vena cava and not maldevelopment of the ureter is the etiological factor responsible. In most of the reported cases the preureteric vena cava was associated with other anomalies of the retroperitoneal veins.

All later attempts at explaining the origin of anomalous retroperitoneal veins are based on the embryological work of McClure and Butler (1925) and Gruenwald (1938). Randall and Campbell Pick and Anson and Gruenwald and Surks have gone thoroughly into the embryology of postcaval ureter and the reader is referred to their papers.

From the Department of Urology (James Buchanan Brady Foundation) of the New York Hospital.

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Commander Moody of the U.S.N. Hospital at St. Albans, N.Y. has notified the author of a sixth patient operated upon by him recently. He severed the ureter and made an end-to-end anastomosis over the vena cava.

Since this article was submitted, an additional case has been reported by Doctors L. F. Greene and W. M. Kearns of the Mayo Clinic. This was the second case in which the diagnosis was made before operation and the fifth case in which plastic repair was done. The ureter was severed and anastomosed in its upper portion.

Briefly, in the development of the embryo three bilaterally symmetrical pairs of veins appear in the lumbar region the posterior cardinals (lateral) the subcardinals (ventral) and the supracardinals (dorsal). Numerous anastomoses between these form venous rings. Quoting from Pick and Anson

"During fetal life the permanent kidney (metanephros) having developed in the pelvis, ascends to the upper lumbar level, passing through a ring of venous channels (perimetanephric or periureteral ring). The ventral limb of the ring is formed by the lumbar division of the postcardinal vein and the subcardino-postcardinal anastomosis (McClure and Butler) and sacrocardinal vein according to Gruenwald. The dorsal limb is a derivative of the lumbar division of the supracardinal vein and the subcardino-supracardinal anastomosis (McClure and Butler) or sacrocardinal vein of Gruenwald."

"Normally the postrenal portion of the inferior vena cava arises from the dorsal limb of the perimetanephric ring, the ureter thereby being placed in an antecaval position. But, in the anomalous arrangement of the ureter and vessel, one of the following developmental alterations occurs: (1) the ventral rather than the dorsal limb persists, the ureter then being postcaval; (2) the dorsal limb fails to arise at all—with similar results; (3) both limbs are present and persistent—the ureter passing between the cavae."

Most writers on the genesis of this anomaly agree that it forms from that limb of the embryonic perimetanephric ring which normally degenerates, that is, according to McClure and Butler the cardinal vein. However two later writers (Gruenwald and Surks) after going very extensively into the embryology express the opinion that the preureteric vena cava is a derivative of the subcardinal rather than the cardinal vein.

SYMPTOMATOLOGY

Symptoms, when present, are those of ureteral obstruction. The condition may be present throughout life however without causing symptoms.

Examination of most of the kidneys in adults showed hydroureter and in varying degrees, hydronephrosis and pyonephrosis. Stone formation was an occasional accompani-

None of the 3 cases in infants showed

of obstruction

Hydronephrosis may be sure exerted by the vena ca

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nder

lying ureter, or by kinking or stricture due to the anomalous course of the duct. Uebelhoefer states that in certain cases the constriction may be due to the right ovarian vein crossing the postcaval ureter.

In our own case the symptomatology consisted of dull backache high up between the shoulder blades of 3 weeks duration accompanied by hematuria on two occasions severe headache at night and intermittent burning on micturition.

DIAGNOSIS

In only 1 of the reported cases (Harrill's) was the diagnosis made preoperatively—a not extraordinary fact perhaps, when one considers the extreme rarity of the anomaly. Cognizance on the part of the examiner that the condition may exist would appear to be a most important factor in preoperative diagnosis since the x ray findings are quite distinctive.

In Harrill's case the clinical picture was that of obstruction. Bilateral stereoscopic pyeloureterograms revealed a hydronephrotic right kidney with an elongated pelvis. From the preteropelvic junction the ureter curved upward in a wide arc toward the midline then downward toward the right side after which it continued downward in a normal course. As an important aid in diagnosis this author suggests a complete series of stereoscopic roentgenograms taken in the anterior posterior and oblique positions. He states "When viewed stereoscopically the radius of curvature should be great enough to include a structure having the diameter and position of the vena cava."

Another distinctive x ray finding that has been pointed out is the peculiar position that the ureter takes to the spinal column when seen in a roentgenogram which shows the spine fall away from the normal position. In

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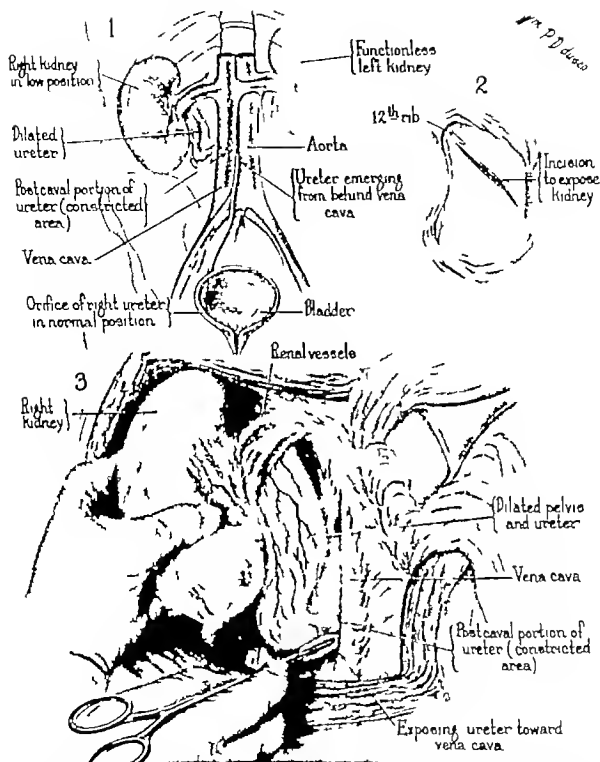


Fig. 1 Condition before operation. Right kidney in low position, ureter passes behind vena cava, and this portion of ureter is constricted. Left kidney is functionless. 2 Incision to expose right kidney and upper part of ureter. 3 Kidney exposed. Upper part of ureter and renal pelvis greatly dilated. Ureter being freed toward vena cava at point where it passes under the vein. Ureter constricted at this point (indicated by dotted line).

shaped curve with the convexity directed superomedially. The roentgenograms in our case showed the right ureter to be very near

the midline of the spinal column. This patient had a left kidney shadow and a left ureteral orifice in the bladder, but the ureter could not

be catheterized nor was there any evidence of shadow casting material in this region in the intravenous urogram.

In most of the reported cases in which operation was done the clinical picture was that of ureteral obstruction with the cause of the obstruction remaining obscure. It is our opinion that postcaval ureter should be considered in all cases of hydronephrosis of obscure etiology, especially when the roentgenograms show a double right-angled kink with the ureter below this point displaced toward the midline.

TREATMENT

Corrective surgery—namely transference of the ureter from its anomalous position behind the vena cava to a more nearly normal site—is the procedure of choice. In some cases however the kidney will be found so badly damaged that nephrectomy becomes necessary.

A review of the 11 cases in the literature in which operation was done discloses that nephrectomy was performed in 6, nephrothoromy alone in 1, and corrective procedures in 4 (Kimbrough 1932; Uebelhoefer 1936; May 1938; Harrill 1940). In all 4 cases the ureter was divided, disengaged from the retroperitoneal tissues, drawn from behind the vena cava, placed in normal position, and anastomosed. Harrill's was the only case in which the division and anastomosis were above the ureteropelvic junction. The results in all 4 cases were reported as good.

In our own case because it was deemed advisable to preserve the intrinsic nerve supply the ureter was severed at its point of entry into the bladder wall, removed from behind the vena cava and placed in normal position and its end reimplanted in the bladder wall as described below.

The past history was unimportant.

The right kidney could be felt on palpation. The urine showed 10 per cent pus and an occasional red blood cell; the prostatic secretion showed 20 per cent pus. Otherwise the physical examination, including rectal examination, was essentially negative.

A complete urological investigation was done. Cystoscopy revealed trabeculation in the region of the left ureteral orifice and considerable edema of the vesical orifice. A leaf catheter No. 6-F passed to the kidney pelvis on the right side, but a No. 4-F catheter could be passed only about 5 centimeters on the left side. The x-ray films showed a small kidney shadow, high in position, on the left side and a kidney shadow, large in size and low in position on the right side. There was a large moth-eaten shadow opposite the transverse process of the third and fourth lumbar vertebrae and another just opposite the fifth lumbar vertebra; these were thought to be calcified lymph glands. The right pyelonephrogram showed a greatly dilated kidney pelvis and a right-angled kink of the ureter. None of the shadow casting material entered the left side. Excretory urograms at 5, 10, and 25 minutes were made. These showed prompt function on the right side and no evidence of function on the left.

The impression was that the patient had a dead left kidney and a right hydronephrosis with a kink of the ureter.

Two days after admission the right kidney was exposed under spinal anesthesia.

OPERATION

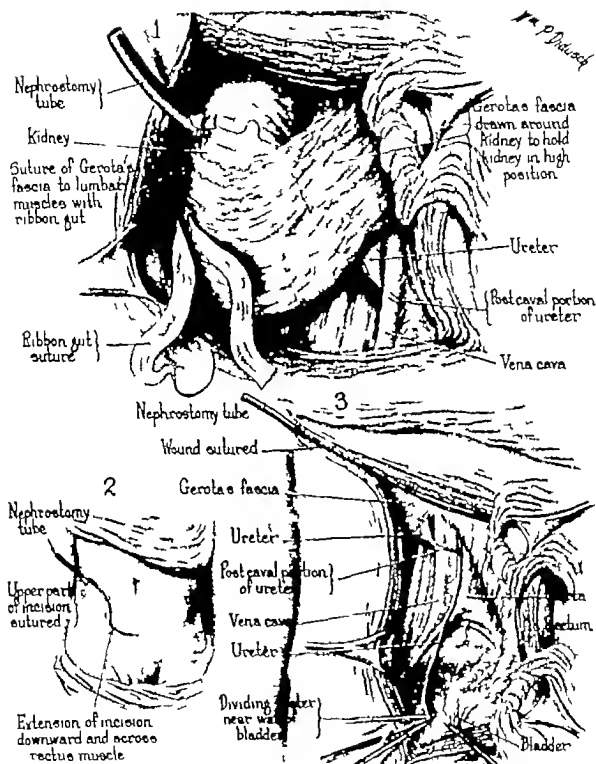


Fig. 2 1 A nephrostomy tube has been placed in the kidney pelvis and fixed in position by ribbon gut. Nephropexy is being carried out by drawing Gerota's fascia around the kidney and suturing it to the quadratus lumborum muscle with ribbon gut. 2, Upper portion of wound partly closed. Incision extended downward and across rectus muscle to expose middle and lower portion of ureter. 3, Entire ureter has been exposed. Dividing ureter close to its insertion in bladder.

The patient was then placed on his back and the lower end of the wound extended down the right border of the rectus muscle and

across its lower end to the midline. The incision was deepened to but not into the peritoneum which was bluntly dissected free and

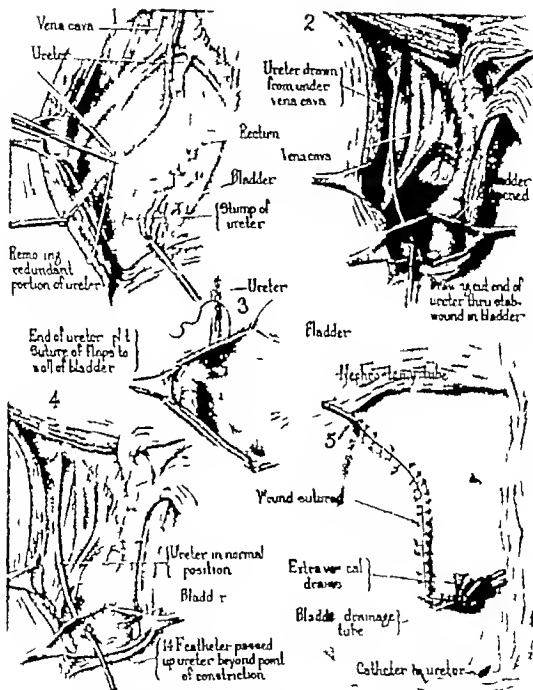


Fig. 3. Removing redundant portion of ureter. 2. Ureter has been drawn from under vena cava cut end being drawn through stab wound in bladder. 3. Cut end of ureter has been split flaps being sutured to bladder wall. 4. Ureter reimplemented in bladder. No. 4 F catheter passed up ureter beyond point of constriction. 5. Entire wound has been closed. A drainage tube has been placed in the bladder and its extravesical drains down to the site of implantation of the ureter. No. 4 F catheter from ureter shows emerging with other drains.

the vena cava exposed. The ureter was identified to it under it, and passing down mesially across the left iliac vein just before it

joined the right iliac to form the vena cava. The entire lower end of the ureter was isolated and because it was thought advis-



Fig. 4. Pyelogram and pyeloureterogram after the injection of 25 cubic centimeters of skiodan.

able to preserve the intrinsic nerve supply of the ureter it was tied off at its insertion into the bladder wall. The ureter was then drawn from beneath the vena cava and brought over the vein the bladder was opened, and the ureter reimplanted into its superior posterior wall and fixed in position with a chromic catgut No. 00 suture about 6 centimeters of the lower end of the ureter being excised to allow it to be straight, without tension.

A No. 14 F splinting soft rubber catheter was inserted into the ureter beyond its narrowed point and brought out through the bladder incision and fixed to the skin of the lower end of the wound. A double suction tube was inserted into the bladder which was closed and the tube attached to the fascia in the lower angle of the wound. Four grams of sulfanilamide were distributed throughout the wound. A drain was inserted to the opening in the bladder and another drain to the anastomosis of the ureter and the bladder.

The wound was closed in layers and the patient returned to his room in good condition.

Postoperative course. After the removal of the splinting catheter the nephrostomy wound continued to drain. Attempts to insert a catheter by means of the cystoscope were un-

availing and 6 weeks after the first operation it was decided that the patient should again be operated upon.

The bladder was exposed by a Pfannenstiel incision extended upward on the right side. It was opened and a No. 10-F catheter was finally passed into the reimplanted ureter after incising the ureter about 3 centimeters above the bladder implantation at which point there was found to be a tight stricture. The catheter was inserted into the kidney pelvis and out through the urethra and fixed in position. The ureter was closed by 3 interrupted mattress sutures of No. 0000 catgut. The wound was closed in layers without a drainage tube in the bladder and the patient was returned to his room in good condition. The No. 10-F ureteral catheter thus passed from the kidney pelvis through the bladder and the urethra.

Subsequently a discharging sinus required still another operation at which time it was found that an abscess had developed about the lower end of the ureter and a considerable portion of the duct had sloughed off. The lower end of the ureter was, therefore, implanted into the skin.

The patient has made an uneventful recovery from this final operation. The catheter

passes to a bag strapped to his leg, and he goes about his work handling this apparatus very well. Indeed

SUMMARY

1. Postcaval ureter is a very rare anomaly, the present case being the thirty-fourth to be reported in medical literature.

2. This is an anomaly of the embryonic vascular system rather than the urinary, being due to faulty development of the inferior vena cava. The pre-ureteric vena cava is usually associated with other anomalies of the retroperitoneal veins.

3. Of the 34 reported cases, 22 were discovered at postmortem examination or laparotomy dissection, 11 (including ours) at operation, and only 1 preoperatively.

4. Postcaval ureter may be present throughout life without producing symptoms. Symptoms when present are those of ureteral obstruction, which may be produced by pressure exerted by the vena cava upon the underling ureter, or by kinking or stricture due to the anomalous course of the ureter.

5. Stereoscopic roentgenogram taken in the anterior, posterior, and oblique positions aid in the diagnosis. The x-ray appearances are distinctive in the following respects: (1) In an oblique film the portion of the ureter dorsal to the vena cava will impinge against the lower lumbar spine, whereas the normally situated ureter will fall away from it. (2) The postcavally placed ureter is always displaced toward, to, or even beyond the midline of the body. The ureter winding around the vessel forms a sickle-shaped curve with the convexity directed supermedially.

6. Severe damage to the kidney may require nephrectomy. Otherwise corrective surgery—namely, transection of the ureter from behind the vena cava to its normal position in front of the vessel—is the treatment of choice.

7. Only 4 cases treated by corrective surgery have been reported previous to our own.

In 3 of these, the ureter was divided and anastomosed in its upper portion; in 1 the division and anastomosis were above the ureteropelvic junction.

8. The operation described here aims at the preservation of the ureter's intrinsic nerve supply while correcting the anomaly. The ureter is severed at its point of entry into the bladder wall, removed from behind the vena cava, placed in normal position, and its end reimplanted into the bladder wall.

CONCLUSIONS

1. Postcaval ureter should be considered in all cases of hydronephrosis of obscure etiology, particularly when the roentgenograms show a double right-angled kink with the ureter below this point displaced toward the midline.

2. Division of the ureter at its vesical end and reimplantation into the bladder wall is preferable to division and anastomosis higher up because (1) the peristaltic wave is not interfered with, and (2) stricture at the site of repair is less likely to occur.

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TOPICAL PENICILLIN TREATMENT OF ESTABLISHED INFECTION IN COMPOUND FRACTURE WOUNDS

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REPORTS concerning the use of parenteral and local penicillin therapy in the treatment of established suppurative infections in compound fracture wounds have been generally pessimistic. The poor results with parenteral therapy are explained by the failure of all but a small proportion of the administered penicillin to permeate the edematous indurated zone of tissue which forms a wall about the site of infection. The principal advantage of local therapy is the high concentration of penicillin which is maintained at the site of infection. The chief objection to this method has been the difficulty of instilling the penicillin solution at frequent enough intervals and with sufficiently sterile technique to obtain the maximum benefits. The purpose of this report is to describe a method of topical penicillin therapy which overcomes these difficulties and which has proved itself to be highly effective in a group of cases which had been refractory to previous treatment by other methods.

The cases in which this method was used were of compound fracture wounds in which established infection had existed for periods ranging from $2\frac{1}{4}$ to 27 months before starting the method to be described in which penicillin jelly, a mixture of penicillin with lubricating jelly is applied to the surface of the wound. For the most part, the wounds were produced by shrapnel machine gun fire and rifle fire with resulting extensive destruction of soft tissue and bone. All of these cases had been refractory or had shown little progress with previous treatment, and have shown a greatly increased rate of healing with the change to topical application of penicillin jelly. In some instances this response has been spectacular healing taking place within a few weeks in wounds which were resistant to other methods of treatment for a period of months.

The average time between wounding and the start of penicillin jelly treatment in the 28 patients comprising this series was 10.34 months. The average time between the initiation of penicillin jelly therapy and complete healing in 23 of the 28 patients was 1.16 months. There were two failures with the penicillin jelly treatment in the sense that the soft tissue wounds failed to heal completely. Three patients remain unhealed at the time of this report but their progress indicates that healing will be complete within a reasonable period without changing the type of therapy. These wounds had existed for an average period of 16 months prior to penicillin jelly treatment, and showed satisfactory progress but incomplete healing after an average period of 4 months of this therapy.¹

RATIONALE OF TOPICAL PENICILLIN THERAPY

The pathologic process at work in old compound fracture wounds is a vicious circle in which localized infection of bone usually goes on to sequestration. The infected bone and the sequestra act as local sources for further infection of bone and surrounding soft tissues which in turn causes further degeneration and sequestration. The cycle will continue as long as sequestra are present or suppuration persists.

The aim of the penicillin treatment is to break up the vicious circle by eliminating or minimizing the infection in the wound while awaiting sequestration and to arrest infection after sequestra are eliminated. The penicillin mixture to be described when retained in surface contact with the suppurating area in sufficiently high concentration acts as a strong deterrent to infection and when used in conjunction with adequate drainage elimination of sequestra, aseptic technique and general supportive measures has proved to be

¹Observation of these patients as interrupted by the transfer of the author to another hospital.



Fig. 2. Case 2. a, Appearance of tibia, June 9, 1944. A large fragment of devitalized bone was left *in situ* because of the possibility of its regeneration. b, Appearance of the tibia August 10, 1945. The degenerated fragment now shows definite evidence of regeneration, with callus bridging the former gap between the fragment and the shaft of the tibia.

far more effective in promoting healing than has any other method previously used by us in this type of disease.

TECHNIQUE OF TOPICAL APPLICATION OF PENICILLIN

A mixture of penicillin and lubricating jelly in the proportion of 1000 units per cubic centimeter is applied directly to the wound at each dressing the standard United States Army lubricating jelly containing phenylmercuric acetate 1:6000 glycerite of tragacanth quince seed and aromatics being used.¹ This vehicle which is water soluble releases penicillin more readily than would an ointment base and its consistency assures its contact with the wound for several days. The acidity of the lubricating jelly which is in the vicinity of pH 4.4 apparently does not inhibit the action of the penicillin. The peni-

cillin jelly is prepared by mixing 1 cubic centimeter of normal saline solution containing 20,000 units of penicillin with 19 cubic centimeters of autoclaved lubricating jelly in a sterile medicine glass. This mixture is prepared just before beginning the wound dressings and is usually sufficient for 6 to 8 dressings. The wound is cleansed with hydrogen peroxide followed by normal saline solution, immediately preceding the application of the penicillin jelly. Hydrogen peroxide appears to be a valuable adjunct in the treatment and there is no evidence that it lessens the effectiveness of the penicillin when it is used in this manner. Normal saline solution was used alone in some of the earlier treatments and the results were less satisfactory.

Lubricating jelly is in itself a bacteriostatic agent and probably enhances the value of penicillin. An opportunity to compare the effects of penicillin jelly and lubricating jelly without penicillin was afforded in a patient

¹The preparations of lubricating jelly on the general market should be tested for pH and for possible inhibiting action on penicillin before they are used as described here.



Fig. 1 c, Filling of wound defect by blood clot. The clot was infected with penicillin solution and was overlaid with penicillin jelly to prevent infection and thus encourage organization. d, Final wound healing following split thickness skin grafting of the surface of the organized blood clot.

with wounds on the medial and lateral aspects of the leg. Penicillin jelly was used on the severe medial wound and the standard lubricating jelly was used on the relatively minor lateral wound. After 2 weeks of treatment the medial wound was completely healed while the lateral wound showed only moderate improvement. This and other observations offered convincing evidence that the beneficial effects of penicillin jelly are not due to lubricating jelly alone.

Dressings were made at intervals varying from daily to every fifth day during the experimental phase. In most instances there was evidence of bacterial growth if the dressing interval extended beyond the third day. The most favorable response was with dressings daily or every other day, and since the wounds did just as well with dressings every other day that interval is now used routinely. The only exception is in the first few days of the treatment when suppuration is profuse. At that time it is well to apply the penicillin

mixture daily, its efficacy being lessened by the mixture with pus. After several days, often within 2 days, the wound becomes so dry that the gauze dressing is found to be fixed firmly to the wound at each dressing. This adherence is due to the drying action of the lubricating jelly and to the lessened purulent secretion.

Strict surgical technique is observed in performing the dressing. This is especially important in a large ward with a variety of septic wounds where cross-infection with organisms of high virulence is a constant danger. The dressers wear caps, face masks, and gowns; the patient's mouth is away from the wound, and the dressings are done in a private room whenever possible in order to avoid the dust of the ward. Casts are changed if they become soiled with exudate. Instrument technique is used throughout.

Treatment with penicillin jelly has distinct advantages over the method of instillation of penicillin solution through tubes. The latter



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Fig. 2. Case 20. a, Perforating wound of lower third of femur with depression due to loss of soft tissue and bone. b, Appearance of soft tissue wound 20 months after wound ing. Exposed bone is partially covered with suppurated g

granulation tissue. c, Treatment of the wound with penicillin jelly for 27 days followed by split thickness skin grafting of exposed bone surface has resulted in complete healing.

method was used in earlier cases, but was discontinued because of the difficulties encountered in administering the treatment. The chief objection was that the instillations were often made by unskilled personnel and it was impossible to prevent micro-organisms from entering the wounds through the tubes due to errors in handling syringes and in managing the ends of the tubes. Three of 10 wounds thus treated became contaminated with *Bacillus pyocyaneus* within a period of 2 days. Another objection was the work entailed in making the instillations at intervals of 3 hours in a large number of cases.

BACTERIOLOGY

Bacteriological studies were made to determine the organisms present in the wounds and to determine the resistance of the infecting bacteria to various concentrations of penicillin. The finding of especial interest was the tendency of organisms which persisted in the wounds to show a progressively increasing resistance to the action of penicillin. This was particularly noticeable with *Bacillus proteus*. With the beginning of treatment several

wounds showed cultures of *Bacillus proteus* which were completely inhibited by concentrations of penicillin as low as 25 units per cubic centimeter. Cultures taken after 2 weeks showed *Bacillus proteus* from the same wounds to be completely resistant to concentrations of 1000 units per cubic centimeter. For the most part *Bacillus proteus* was resistant from the beginning to concentrations of 250 units per cubic centimeter or higher. This was also the case with *Bacillus pyocyaneus*. *Staphylococcus* was susceptible to low concentrations of penicillin in most instances. Twelve cultures showed complete inhibition with 25 units or less; 1 was susceptible to 100 units and 1 to 250 units. There was little opportunity to check variations of susceptibility in this organism during penicillin therapy as the *staphylococcus* usually disappeared after a few days of treatment. Organisms which showed complete resistance to concentrations of 1000 units of penicillin per cubic centimeter including *Bacillus proteus* and *Bacillus pyocyaneus*, did not prove to be troublesome contaminants, and usually disappeared from the wounds within a few

weeks. There has been an unusually high incidence of *Bacillus proteus* in this group of patients. This may be explained by the fact that a majority were previously treated with penicillin intramuscularly or with sulfonamides and the resistant *proteus bacillus* remained in the wounds after other organisms had been made to disappear.

Suppuration has been controlled in all of the wounds treated by this method regardless of types of bacteria present so it is not considered essential to make detailed bacteriological studies except for investigation purposes.

CLINICAL AND PATHOLOGICAL FEATURES OF WOUNDS TREATED

The 28 cases of compound fractures with long standing wound infection which comprise this series had been refractory or were slow in response to treatment by other methods before beginning the treatment with penicillin jelly. Wounds of short duration and wounds which were near completion of healing when the penicillin jelly treatment was started are not included in this report. The injuries treated involved the following bones:

	cases
Tibia, or tibia and fibula	16
Tarsal and metatarsal bones	5
Femur including hip joint	3
Shoulder joint, involving head of humerus	2
Shaft of humerus	
Sacrum, complicated by pelvic abscess	1

The local pathologic changes which were considered most significant in influencing the course of the disease were suppurative cellulitis, edema of varying degree, localized degeneration and necrosis of bone with or without sequestration, degeneration and necrosis of the soft tissues and impairment of regional circulation due to direct injury, edema, thrombosis and trophic changes. In addition there are to be considered the variables of the injuring force and the depth and irregularity of the wounds. As stated previously the types of bacteria did not appear appreciably to influence the course of the healing.

INFLUENCE OF BONE SEQUESTRATION ON WOUND HEALING

The course of wound healing was influenced as much by the proper removal of sequestra as



Fig. 3. Case 21. a, left, Appearance of femur 7 months after refracture. An intractable draining wound persisted throughout this period and was thought to be responsible for lack of tendency to union. b Secondary closure following 31 days of penicillin jelly treatment resulted in permanent healing of the soft tissue wound and union of the fractured femur.

by any other factor. Removal of large sequestered fragments was delayed as long as there appeared to remain a possibility of revascularization. This has caused a delay in healing in some cases because of the eventual complete necrosis of the fragment but the value of the segment if it did revascularize more than compensated for the delay in healing time. The following case illustrates this point.

CASE 22. Revascularization of devitalized bone segment (Fig. 1)

Patient, aged 30 years, was wounded in combat by shrapnel early in February 1944 sustaining a severe



Fig. 4. Case 18. a, left, Perforating fracture of sacrum with bullet lodged in pelvis. Multiple operations for drainage over period of 13 months, and removal of the bullet were unsuccessful in arresting suppurative infection of pelvis. b, Location of anus tract, originating in the pelvis and emerging over the left greater trochanter.

compound comminuted fracture of the middle third of the tibia. Early treatment included débridement sulfadiazine orally and closed cast which was continued until June 12, 1944, at which time it was decided not to remove a large devitalized segment of cortical bone because of the certainty of weakening the tibia by its removal.

The wound was then treated for several months with various topical medications including sulfathiazole ointment azochloramide solution and aqueous solution of penicillin in the strength of 1000 units per cubic centimeter. The wound remained indolent with little roentgenological evidence of bone regeneration in the devitalized segment of tibia.

Penicillin jelly treatment was instituted December 11, 1944, following which there was prompt epithelialization of the wound together with evidence of progressive regeneration in the devitalized bone and union of the fracture.

Small spicules of sequestered bone became detached from the regenerating cortical fragment from time to time and operation was performed on March 14, 1945 for removal of devitalized bone from the surface of the fragment. The wound defect was allowed to fill with blood. It was not possible to close the soft tissues over the defect. The blood clot which formed was treated with injections of several drops of penicillin in normal saline solution 1000 units per cubic centimeter on the first third and fifth days following operation. Intramuscular injections of penicillin, 20,000 units every 3 hours were given for a period of 15 days beginning 2 days before operation. The blood clot was covered with penicillin jelly.

The clot became organized in 3 weeks and was then covered with split thickness skin grafts. Sur-

with contrast medium show the principal pocket in the left iliac region within the pelvis. The abscess, which had persisted for 30 months, became healed after 4 days of treatment with penicillin jelly injected into the tract every other day. Observation for 6 months following healing shows no evidence of recurrence of infection.

face healing was complete on April 30, 1945. Later x-ray examinations showed satisfactory union of the revascularized segment with the shaft of the tibia.

The importance of carefully planning the operation of sequestrectomy cannot be overemphasized. The sequestrum should be accurately localized beforehand by roentgenographic study with views in addition to the standard anteroposterior and lateral whenever necessary. The incision is planned to permit a direct approach to the necrosed bone with a minimum of disturbance to living bone and soft tissues. In some of our patients it was necessary to make the incision through normal skin away from the wound to accomplish this. In 2 instances in this series, wound healing was unnecessarily delayed because of failure to remove all of the sequestra present. In these cases the operative incisions were inadequate for proper exposure of the diseased area.

All operations of sequestrectomy as well as other types of revision operations are preceded and followed by several days of intramuscular penicillin therapy.

The particular advantage of topical treatment with penicillin jelly in wounds harboring sequestra is that further necrosis of soft tissue and bone is held in check by the inhibiting effect of the penicillin on the infection thus

breaking the vicious circle described previously

PRESENCE OF DEGENERATED BONE

The difficulties of management of degenerated bone are much the same as with sequestra. Degenerated bone causes greater delay than does sequestered bone because it is impossible in most instances to determine whether the degenerated bone will revascularize or will go on to necrosis. Extensive loss of bone makes it necessary to conserve as much osseous tissue as possible therefore one must guard against sacrificing bone in which there remains any possibility of revascularization. The point is stressed that, although early healing is desirable, it is not so important that it should be attained through the sacrifice of valuable fragments

EXCAVATED WOUNDS

Depressed wounds due to loss of bone substance especially those in which bone remains exposed, are definitely a cause of delayed healing. This is noteworthy in shoulder wounds with partial or complete loss of the head of the humerus in which the wound is held open by the surrounding bony prominences. Two such cases in which healing was making little progress with sulfathiazole ointment, azochloramide instillations and penicillin instillations used successively showed a remarkably rapid response to penicillin jelly

CASE 25 Healing of shoulder defect

Patient aged 20 years was wounded in action on June 24 1944 sustaining a mortar shell injury with a severe compound fracture-dislocation of the head and neck of the left humerus, together with other injuries

The wound was debrided and an Orr dressing in shoulder spica cast was applied. He was evacuated to the United States after several months arriving at this hospital September 5 1944. Removal of the cast several days after his arrival here revealed a deep cone shaped wound on the prominence of the shoulder measuring 5 centimeters in diameter and 6 centimeters in depth.

Closed cast treatment was continued until October 18 1944 after which time the wound was dressed through a fenestration with hydrogen peroxide cleansing and 5 per cent sulfathiazole ointment. Healing progressed slowly and on November 16 the local therapy was changed to instillations of

aqueous solution of penicillin 500 units per cubic centimeter through a small caliber soft rubber tube every 4 hours. Some improvement was noted with this change in treatment, but the method was cumbersome and there was evidence of wound contamination apparently due to faulty technique in making the instillations.

Penicillin jelly treatment was started December 11 1944. Improvement was noticed within a few days and the wound which had remained almost stationary at 2 centimeters in diameter and 3 centimeters in depth for some weeks previous to the use of penicillin jelly now healed rapidly and was completely closed on January 30 1945.

Arthrodesis of the shoulder was performed on April 12 1945 with primary healing of the surgical wound.

Healing by organization of blood clot was accomplished in 4 cases of tibial defect. Blood was permitted to fill the defect following sequestrectomy and saucerization of the bone. The resulting blood clot was injected with a few drops of a solution of 1000 units of penicillin per cubic centimeter of normal saline solution. The surface of the clot was protected by a dressing of penicillin jelly. Wounds treated in this manner showed gross evidence of organization of the blood clot 3 to 4 weeks after operation. In 2 instances the organizing clot was overlaid with split thickness skin grafts 4 weeks after operation. None of the clots liquefied or became infected, and there was only slight depression of the area on completion of healing. In the light of previous experience with organization of exposed blood clot it is reasonable to assume that penicillin played an important rôle in the healing in these cases (Fig 1, c and d).

CASE 14 Healing by organization of blood clot.

Patient, aged 27 years was injured by shrapnel in combat with the enemy October 26 1944 sustaining a severe compound comminuted fracture of the upper portion of the left tibia.

The wound was debrided within a few hours and was treated with sulfathiazole powder vaseline gauze and a circular cast from the toes to the upper thigh.

The dressing was not removed until he reached this hospital January 8 1945 at which time there was evidence of moderate suppuration with fragmentation of the tibia.

Operation of sequestrectomy and osteotomy was performed January 10 at which time several long splinters of necrosed bone were removed. Culture of the wound revealed *Bacillus proteus* which on

testing was inhibited by 250 units of penicillin per cubic centimeter. A large defect in the tibia and soft tissues 10 centimeters in length, 2.5 centimeters in width and 3 centimeters in depth was allowed to fill in with blood clot. Several drops of penicillin in normal saline solution, 1000 units per cubic centimeter, were injected into the blood clot on the first and third postoperative days. The surface of the clot was overlaid with a thin coating of penicillin jelly. The clot organized with moderate retraction, and was covered with split thickness skin grafts on February 7. All grafts were successful, and healing of the wound was complete on March 1, 1945.

EXTENSIVE LOSS OF SOFT TISSUE WITH EXPOSURE OF BONE

Exposed bone is a deterrent to wound healing because of its tendency to degeneration and necrosis as long as it remains uncovered even though infection is held in check. Therefore an effort is made to cover the exposed bone with soft tissue at the earliest favorable time. Good results have been obtained by placing split thickness skin grafts directly on bone after gross evidence of necrosis and infection has disappeared even though wound cultures remain positive. The skin-grafted surface is treated with compression dressings moistened every other day with normal saline solution containing 1000 units of penicillin per cubic centimeter and compression is maintained for a period of 8 to 10 days. This procedure was used in 5 cases in which an infected open wound had been present for from 6 to 28 months. All except 1 healed completely. The single case of failure was a tibial compound fracture wound which had remained open with bone exposed for 20 months following metal plating. There was no gross evidence of bone necrosis or suppurative infection following operation of skin grafting and it is probable that failure was due to inadequate circulation in the exposed bone.

CASE 20. Skin grafting of exposed bone surface following treatment with penicillin jelly (Fig. 2)

Patient, aged 21 years, was injured by shrapnel in overseas combat April 9, 1943, receiving a perforating wound of the distal third of the femur with loss of the patella.

Treatment prior to his arrival at this hospital April 8, 1944, consisted chiefly of blood transfusions and plasma infusions, penicillin intramuscularly, closed cast treatment, and two operations: sequestrectomy

Examination here disclosed a large open wound on the anterior of the lower third of the thigh with an irregular perforating wound of the femur. The wound was treated with sulfathiazole ointment dressings until October 17, at which time the bone was sauterized to encourage overgrowth of soft tissue.

Topical penicillin in normal saline solution every 4 hours was started November 6, 1944. Cultures at this time showed the presence of nonhemolytic *Staphylococcus albus* and *Bacillus proteus*. The profuse suppuration was lessened, but ingrowth of soft tissue over the large area of exposed femoral bone was negligible.

Penicillin jelly treatment was started December 15, 1944, and the suppuration subsided completely within 10 days. Split thickness skin grafts were applied over an area of exposed bone 5 centimeters in length and 2 centimeters in width on January 11, 1945. All of the grafts remained viable and the wound was completely healed on January 23, 1945.

Secondary wound closure by suturing was usually not possible because of the loss of bone substance and the loss of overlying soft tissues. Only 2 cases in the series were suitable for this procedure. One of these described in the following case history illustrates the favorable effect of the procedure on a fractured femur which had shown little tendency to unite before the wound was closed secondarily.

CASE 21. Secondary wound closure by suturing (Fig. 3)

Patient, aged 24 years, received a bullet wound November 24, 1943, which caused a fracture of the middle third of the left femur. He was treated in traction, followed by hip spica cast until May 30, 1944.

He refractured the femur June 17, 1944, while out of cast, and was admitted to this hospital 1 month later. Examination here disclosed a comminuted simple fracture of the middle third. The extremity was put in traction. An abscess formed in the soft tissues in the region of the fracture and this was drained August 22, 1944. His condition, which had been critical, improved rapidly following adequate drainage. However drainage continued unabated. A large femoral fragment showed evidence of advanced degeneration and showed little tendency to unite to the proximal and distal main fragments. The soft tissue wound was intractable to treatment with sulfathiazole ointment, and showed little response to instillations of azochloramide solution and penicillin solution used successively.

Penicillin jelly treatment was started December 12, 1944, and was continued until January 12, 1945. At that time the trough-shaped wound, measuring 15 centimeters in length and 2 centimeters in depth, showed no suppuration, and was epithelialized ex-

cept in its depth. Secondary closure of the wound was performed January 12, 1945. The wound remains completely healed after a period of 4 months and the femur shows evidence of increase in callus formation with apparent union.

INACCESSIBLE WOUNDS WITH SINUS TRACTS

There have been several cases of deep sinus tracts in which it was inadvisable to explore the depth of the wound by surgical operation. These patients were examined roentgenologically following injection of a radiopaque medium into the tracts through a soft rubber catheter after making certain that there was free exit for any substance injected. Following this examination to determine the extent of the pockets of infection, penicillin jelly was injected into the sinus tracts every other day. The merit of the use of penicillin jelly in these cases lies in the fact that it is apparently harmless when it is retained in the wound. One of the patients treated in this manner a pelvic abscess secondary to a bullet wound through the sacrum is of especial interest.

CASE 28. Healing of inaccessible wound with sinus tract (Fig. 4).

Patient aged 24 years received an accidental .45 caliber bullet wound on June 12, 1943, the bullet entering the left gluteal region, piercing the middle third of the sacrum, tearing segments of small bowel and sigmoid, and lodging in the pelvis. The intestine was repaired 2 hours later.

A large subpubic abscess was drained June 25, 1943, and a left retroperitoneal abscess was drained August 12, 1943.

A flexion deformity developed gradually in the left hip and the hip became ankylosed with destructive changes in the joint cartilage. The earlier drainage of the pelvic abscesses had resulted in a persistent sinus emerging in the left lower anterior abdominal wall. In November 1943 x-ray of the tract, with iodized oil as a contrast medium, showed ramifications extending toward the crest of the left ilium, the hip joint, and the ischium.

A total of 20,300,000 units of penicillin was given intramuscularly from February to August, 1944. Cultures of hemolytic streptococcus from the tract were reported during this period.

Exploratory surgical incision was made in the left hip region over the greater trochanter on March 22, 1944. There was no pus found in the hip joint. An abscess broke through the exploratory hip incision on April 5, 1944. A subsequent pelvic operation performed July 26, 1944, was unsuccessful in arresting the drainage from the sinus in the left hip region.

The patient was transferred to this hospital September 10, 1944. At that time all surface wounds

were closed except the sinus tract emerging at the left hip. Wound culture showed nonhemolytic *Staphylococcus albus*, nonhemolytic streptococcus, and *Bacillus proteus*. The bullet was removed from the pelvis November 30, 1944. There was no change in the drainage of pus from the sinus tract of the hip following this surgical procedure. No pus was seen in the vicinity of the bullet at the time of its removal.

X-ray examination following injection of the sinus tract with radiopaque medium showed essentially the same findings as those previously described with the exception that the abscess in the lower left pelvis was more clearly defined.

Injectations of penicillin jelly into the sinus tract were started January 16, 1945. The injections were made every other day through a No. 12 soft rubber catheter, 2 cubic centimeters of the jelly being instilled with very moderate pressure. The tract became completely closed on January 30, 1945, for the first time since the development of the sinus on March 22, 1944, and has now remained closed for a period of 6 months. The white blood cell count and temperature remain normal and the patient is completely well except for an almost complete ankylosis of the left hip joint.

It is possible that removal of the bullet played a part in the healing in this case but the fact that no communication was demonstrated between the bullet and the abscess at the time of operation and the fact that the purulent drainage which had continued for 6 weeks following operation ceased promptly after penicillin jelly instillations would argue for penicillin jelly being the major factor.

INFLUENCE OF GENERAL DISTURBANCES ON WOUND HEALING

General factors which should be given consideration are the state of body nutrition, the character and volume of blood, protein sufficiency, vitamin balance, and concurrent diseases. It is difficult or impossible to measure the degree of departure from normal with ordinary methods in most of these factors except when the departure from normal is extreme. Nevertheless, it must be accepted that such disturbances do exist in chronic suppurative infections and that they should be considered as factors in influencing healing.

Protein insufficiency is a constant accompaniment of prolonged severe suppuration and a high protein diet is important in helping to overcome this deficiency. This is especially important for the soldier returned from a distant outpost where some essential foods are

lacking and certain types of malnutrition are prevalent. Edema of the tissues in and around the wounds is interpreted as serious protein deficiency if circulatory cause can be ruled out. It has not been considered necessary to measure the proteins of the blood or to determine the albumin-globulin relationship except in patients with pronounced edema.

Vitamins which are known to be of importance in wound healing particularly vitamin C have been found to be low in most of the cases in this series. The need for this vitamin and vitamin B complex in greater quantities in those suffering from suppurative disease or in those who are undergoing wound healing has been satisfactorily demonstrated by research workers. The diet is supplemented with liberal amounts of orange juice and in addition to this a supplement of vitamin C is given intramuscularly if the patient shows a low vitamin C blood level. These include patients showing less than 0.8 milligram per 100 cubic centimeters of blood.

A continued low blood level that does not improve with transfusions and adequate diet is usually due to suppuration. In such cases attempt is made to control infection by removal of sequestra or improvement of drainage.

Optimum circulation in the injured part is maintained by proper elevation by application of warmth in cases of vascular injury and by bandaging and splinting in such a manner as to prevent unequal pressure with its consequent accumulation of venous blood in the region of the injury. In this connection the principles of supportive and compressive bandaging used in the treatment of varicose ulcers applies equally well to established compound fracture wounds of the leg.

Local and general physical conditioning of the patient is continued throughout the treatment except during periods immediately following major operations of sequestrectomy, drainage, or wound revision. Exercises are directed toward the conditioning of muscles in the affected extremity and muscles in general. This phase of therapy is especially important in patients whose wounds require months for healing.

SUMMARY

1. A method of topical application of penicillin in lubricating jelly in the treatment of established infection in compound fracture wounds is described. It has the advantage of maintaining high concentrations of penicillin in the area of the wound without the use of cumbersome technique or apparatus.

2. Evidence is presented of the effectiveness of this preparation in permeating the barriers in the zone of infection. This is in contrast to parenteral administration in which relatively small amounts of penicillin reach the area of suppuration.

3. Twenty-eight compound fracture wounds with established infection have been treated by this method. They had been refractory or slow in response to accepted methods of therapy for periods varying from 2 to 27 months, and all except 2 have shown a highly satisfactory response to treatment with penicillin jelly.

4. Delay in the healing of old infected compound fracture wounds is most frequently due to the presence of necrosed bone. The presence of devitalized bone sets up a vicious circle in the wound by encouraging infection which in turn causes further necrosis of bone. Penicillin jelly has proved itself to be effective in breaking up the vicious circle by eliminating or minimizing infection even in the presence of necrosed bone, and by inhibiting the soft tissue and bone infection after the sequestra are removed.

5. Skin grafting, secondary wound closure and healing by organization of blood clot have been successful in most instances in the patients in this series treated with penicillin jelly. From the author's experience and the experience of others, such procedures would seem to have been less successful without its use.

6. Topical penicillin therapy is to be considered as a part of a general plan of treatment. Good surgical judgment, proper surgical technique, maintenance of an optimum circulation in the injured part and maintenance of a proper state of nutrition are absolute essentials in the treatment.

IS THE BIOPSY OF NEOPLASMS DANGEROUS?

An Experimental Study

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CLINICIANS are prone to avoid the incision or removal of neoplasms for fear that the diagnostic procedures may serve to disseminate tumor cells but the reluctance to obtain a biopsy specimen for histologic study often delays adequate therapy and invalidates an accurate diagnosis. It is generally accepted as a truth—and there is some experimental evidence to support the belief—that the rupture of the capsule of a tumor or the destruction of adjacent tissue structures incurred in obtaining a biopsy specimen may serve to open vascular and lymphatic channels to tumor cells. Physicians therefore avoid manipulation of suspected tumors in order to prevent local extension or metastases. These concepts imply that the extent of neoplasms can be roughly judged by gross inspection and that tumor metastases are usually limited by the observed tissue barriers.

Clinical evidence supports the theory that any degree of trauma either accidental or surgically intended may serve to disseminate a malignant tumor and in rare instances to alter the nature of a benign growth. Thus students are cautioned by their elders not to squeeze or unnecessarily disturb a tumor in deed at times only a single student of an eager class is favored with an opportunity to touch gingerly the restrained new growth. Thus medical novitiates learn to regard any new lump fearfully as though its mysterious walls might disintegrate if the tumor cells were disturbed. Thus acquired fear of tumor dissemination is readily increased as the physician may unjustly attribute rapid and abundant embolic phenomena to his operative intervention in a seemingly localized new growth.

If one should accept the aforementioned theses that a tumor growth is completely localized

by its capsule, by adjacent tissue barriers or by unyielding vascular channels then interruption of such defenses might lead to a sudden catastrophe with rapid invasion of local and distant parts. However a critical study of surgical and postmortem specimens gives ample evidence that neoplasms are not restrained or unduly inhibited by their capsules or areas of marked desmoplasia since metastases may precede capsule formation and emboli may readily flow in lymphatic channels found in encircling tissue barriers. There is also adequate evidence to suggest that tumor emboli may occur throughout the life of a tumor and that growth in distal parts depends on the adaptability of the invaded tissues to the repeated attacks of viable emboli. It would not be unreasonable therefore to think that inoculation of an organ with a large mass of tumor cells might well produce a viable metastatic focus while an embolus of only a few cells might succumb to tissue defenses. Hence a decrease in the bulk of a neoplasm available for metastases should serve to decrease the incidence of metastatic tumor growth. The most likely danger therefore from cutting into a tumor would be the mechanical transfer of neoplastic cells to the operative incision. This accident seldom follows careful operative procedures.

If one examines the medical literature relative to the danger of biopsy procedures it is obvious that the experimental evidence is contradictory and inconclusive. It is therefore not surprising that clinicians are in a quandary when confronted by a suspected malignancy. The value and the dangers of biopsy were stressed in the medical literature in 1917 (3) when it was proposed to submit biopsy specimens to the Health Department of New York City. In the heat of the controversy editorialists and numerous articles written by clinicians vigorously condemned the practice of obtaining such specimens. Well known surgeons of

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that day referred to a biopsy as a criminal act, since 'incision into a breast tumor renders the prognosis grave or hopeless. The late Dr Ewing however was of the opinion that a clean surgical incision produced no untoward results and pointed out that the diagnosis was often impossible without histologic study. Tyzzer in 1913 demonstrated that daily massage increased the number of metastases in experimentally produced tumors in animals. F C Wood in 1919 injected rats with small pieces of a carcinoma and after several weeks excised parts of the tumor in one group and the entire tumor in a second group. Animals of a third group were used as controls. The animals were sacrificed in 3 to 4 weeks. The percentage of metastases in the third group that in which biopsy specimens were not obtained was 32 while in the first group the percentage of metastases was 22. In the group in which the tumors were completely excised the percentage was 21.8. In 1922 Knox in the same laboratory inoculated mice with a transplantable tumor and massaged the resulting growths daily. These inoculated animals and the animals of a control group were sacrificed 4 weeks following inoculation. It was apparent from this experiment that massage promoted metastases. Marsh working with spontaneous tumors in mice found that massaging these breast tumors increased the percentage of pulmonary metastases.

In a carefully controlled clinical study, Peterson and Nuttall selected two groups of squamous cell carcinomas of which the size, treatment, and course could be readily observed. From one group a biopsy specimen was removed with no attempt to control the degree of trauma. In the control group diagnosis was made upon clinical inspection. Both groups of tumors were treated in a similar manner and followed for a period of 2 years. At the end of this period the 166 cases in the two groups were reviewed and it was found that the incidence of metastases had not been increased by the biopsy procedure.

After reviewing the available experimental evidence Peyton was of the belief that the harmful effects of trauma had not been completely proved. He had the clinical impression that infiltration of a tumor with local anes-

thesia could disseminate a neoplasm. He injected mice with various tumors. In one group the tumors were subsequently removed under general anesthesia while in another group local anesthesia was applied about the tumor. In the latter group in which metastases were usually infrequent, pulmonary nodules were abundant following the injection of the local anesthesia. He concluded that the use of local anesthesia for the removal of a neoplasm might be a dangerous procedure.

Since present medical opinion and experimental evidence are not entirely in accord it seemed desirable to investigate the problem further employing more biologically uniform material. With the development of relatively homogenous inbred stocks of rats and mice and a diversity of carcinogenic agents, the experimenter has at his command a limitless array of transplantable tumors with 100 per cent predictability of progressive growth. By the transplantation of small fragments from an induced or spontaneous tumor into any organ or tissue of other hosts of like genetic constitution the experimenter may duplicate many thousands of times, if desired, the growth of the same neoplasm. The difference between these transplanted tumors and the same tumor in the primary host is that the causative agent is not operative in the secondary hosts. However such material is ideally adapted to the study of the effects of any procedure on tumor growth.

MATERIAL AND METHODS

The transplanted tumors used in the present experiment arose spontaneously or were induced in relatively homogenous inbred rats and were transplanted into hosts of the same inbred line. All were progressively growing neoplasms which had been propagated by transplantation from 6 to 150 generations previously.

For the first experiment IRS 4337 a very malignant Cysticercus-induced fibrosarcoma was selected. The history on transplantation of this tumor has been previously described by Dunning, Curtis, and Bullock (1). The rats were inoculated on the right forefoot with 2 milligram grafts of a tumor from the 150th transplanted generation. Nine days after in-

TABLE I--THE AVERAGE SURVIVAL PERIOD AND TUMOR WEIGHT AND PERCENTAGE OF METASTASES OBSERVED IN OPERATED UPON AND UNOPERATED UPON RATS BEARING TRANSPLANTED TUMORS

Exper. No.	No. of rats	Type of tumor	Group	Days survived	Tumor wt. removed (gms.)	Metastasis					
						Lymph node		Lungs		Skeleton	
						No.	Per cent	No.	Per cent	No.	Per cent
	9	Fibrosarcoma	Control								
	9		Biopsy	28							
	9	Adenocarcinoma	Control	42	34	5	79	17	90		
	80	breast	Biopsy	98	24		63	16	84		
3	80	Adenocarcinoma	Control	115	15	3	5	5	26		
	25	breast	Biopsy	110	61	3	15	11	60		
4	24	Squamous	Control	3	20			3	80		
	80	cell carcinoma	Biopsy	93	5*			4			
Average weight of superficial metastases.						53	97	31	91	5	74
					12*	80	100	18	90	15	75

oculation when the tumors averaged about 0.5 centimeter in diameter they were completely excised. No attempt was made to remove a margin of healthy uninvolved tissue. The skin was secured with one or two interrupted sutures.

The tumor used in the second experiment was R 2426 a spontaneous papillary cystadenocarcinoma of the mammary gland. A study of the growth of this tumor on transplants weighing approximately 3 milligrams of a tumor from the 31st generation were inserted under the skin of the right side by means of a trocar. This tumor grows relatively slowly and the biopsy was not performed until 60 days after inoculation when the tumors weighed approximately 5 grams. An incision about 1 centimeter in length was made with a knife through the skin and a wedge shaped slice of tissue about 0.2 centimeter at the margin was removed. Since the tumors were somewhat cystic and hemorrhagic a considerable amount of bloody fluid and tissue exuded through the incision when the capsule was cut. When the hemorrhage subsided the wound was cleansed and closed with a suture.

Rats bearing transplanted adenocarcinoma of the 10th generation of R2572 were used for the third experiment. The primary tumor was a mixed tumor of the mammary gland. The separation of the epithelial portion has re-

cently been described by the authors (2). The tumors were implanted similarly to R2426 and 22 days after transplantation when they weighed approximately 5 grams a simple biopsy was performed. This tumor is fairly firm in consistence and only a small mass of tissue was removed and the wound closed with a suture.

For the fourth experiment rats bearing transplanted squamous cell carcinoma M-C 951 were used. The primary tumor was

induced by a 3 milligram pellet of methylcholanthrene in the prostate gland of an agouti Irish male rat of the 24th BxS generation of Ax-C line 9935 and has not been previously reported. Transplanted tumors of the 7th generation were used for this experiment and the biopsies were performed 20 days after implantation when the tumors weighed approximately 5 grams as in the two previous experiments.

Following the biopsy the tumors were allowed to grow until death of the rat occurred. A careful postmortem examination of the biopsied and control series included measurement and weight of the neoplasm and examination of the superficial lymph nodes, lungs and skeleton for metastases. The lungs were injected with 10 per cent formalin and preserved with a section of the tumor and the lymph nodes for microscopic examination.

All preserved tissues were examined thoroughly. The biopsied series were compared with the control series for the average number of days which they survived after transplantation and for the percentage with metastases.

RESULTS

The results are summarized in Table I. In the first experiment 19 rats of the control series bearing fibrosarcomas survived an average of 28 days after inoculation. The tumor removed postmortem weighed an average of 21 grams 15 or 79 per cent, of the rats had lymph node metastases and 17 or 90 per cent, were found to have lung metastases. In the experimental series the 19 rats which had their tumors excised 9 days after inoculation survived an average of 43 days. The difference in average survival period of 14 ± 3.8 days is statistically significant and represents the equivalent of nearly a year and a half in a man's life. The average weight of the tumors was 34 grams and larger than the tumors of the control series but the percentage of lung and lymph node metastases was not increased being respectively 84 and 63 per cent.

In the second experiment 19 rats of the control series bearing adenocarcinoma $\frac{R\ 2426}{37\ A}$

survived an average of 98 days. The tumors weighed an average of 24 grams and only 5 or 26 per cent, had lung metastases. One, or 5 per cent, had axillary lymph node metastases. The 20 rats in the experimental series survived an average of 125 days. The average tumor weight was 15 grams. Three or 15 per cent, had axillary lymph node metastases and 12 or 60 per cent, had lung metastases. The difference in average survival period of 27 ± 8.5 days in favor of the rats operated upon is also statistically significant and represents the equivalent of nearly 3 years in a man's life. The tumors were smaller than in the control series averaging only 15 grams. The difference in average weight of the tumors in this series was probably due to more extensive ulceration and the prolongation of average survival time was a result of the removal of a considerable mass of the tumor in the operative procedure. The significant increase in

percentage of lung metastases was a result of the increased survival period. Figure 1 shows the length of survival of each rat in the two series, with the individuals which showed microscopic and gross lung metastases designated by cross-hatched and blackened bars respectively. In the control series 3 rats in which lung metastases were discovered by microscopic examination survived 80, 96 and 100 days. Three rats in which no lung involvement was detected survived 101, 108 and 117 days and the 2 rats with extensive gross metastases survived for 164 and 165 days. Among the rats operated upon microscopic lung metastases were observed in 3 rats which survived respectively 89, 89 and 95 days. Three rats died after 106, 110 and 247 days respectively with no lung involvement and all but 2 which died after 106 and 117 days, respectively of those with gross lung metastases survived any of the control series which died without lung involvement.

In the third experiment 20 rats of the control series bearing $\frac{R\ 2572}{10\ A}$ survived an average

of 110 days after transplantation. The tumors weighed an average of 61 grams and only 3 or 20 per cent, had lung involvement. In the experimental series 18 rats with biopsied tumors survived an average of 113 days with tumors which averaged 39 grams and 4 or 22 per cent, had lung involvement. There were 2 additional rats in this series in which the tumors practically ulcerated out following the operation. These two hosts survived for 276 and 373 days respectively. Both had large tumors at necropsy. One had lung and lymph node involvement and the record on the other was lost. In this experiment employing a tumor of firm consistence in which the biopsy specimen comprised only a small fraction of the mass of the growth, no prolongation of survival period was noted and no difference in the percentage of metastases was detected except in the 2 instances noted in which secondary infection following the operation inhibited the growth of the tumor.

In the fourth experiment 34 rats of the control series bearing $\frac{M-C\ 951}{7\ A}$ survived an

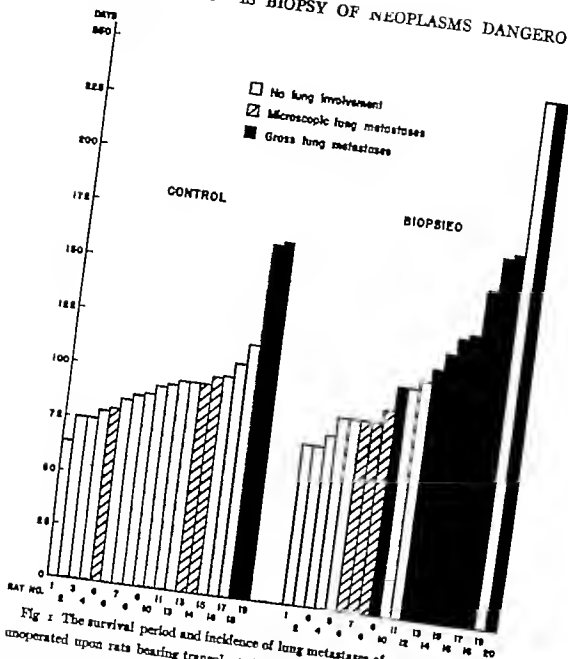


Fig 1 The survival period and incidence of lung metastases of operated upon and unoperated upon rats bearing transplanted adenocarcinoma. R 3495 32 A

average of 93 days and the 20 rats of the experimental series in which the tumors were biopsied 20 days after inoculation survived an average of 95 days. Since these tumors characteristically ulcerate early the tumor weight in both series was based on the combined weight of the superficial lymph node metastases. In the control series the lymph node metastases averaged 15 grams compared with 13 grams in the experimental series. In the control series 31 or 91 per cent, had lung metastases while 18 or 90 per cent, of the experimental series had lung involvement. Skeletal metastases were observed in 74 per cent

of the control series and in 75 per cent of the experimental series. In this experiment like the preceding one in which the biopsy specimen was not a factor in the mass of the growth no difference was detected in survival time or percentage in which lymph node lung or skeletal metastases were observed.

COMMENTS

The concept held by many clinicians that a biopsy may enhance the growth of a neoplasm has long needed further investigation. It is generally recognized that it is often impossible by inspection alone to distinguish benign from

malignant tumors hence it is usually necessary to obtain a biopsy specimen. If physicians were to avoid incising suspicious lesions to obtain a biopsy then the early diagnosis of cancer would obviously be impossible. Unfortunately it is difficult to evaluate the effect of trauma on malignant tumors of man since the heterogeneous hereditary patterns of the hosts differ and the observed tumors seldom are identical in either their gross or their microscopic features.

In the observations recorded here in which homogeneous strains of inbred rats were in oculated with equal portions of the same transplanted tumors one could ascertain the effect of surgical trauma on the neoplasms. It is noteworthy from examination of Table I that if one removes a portion of a tumor he increases the length of life of the animal this increased survival is due presumably to the decrease in the quantity of cells available for growth. Such data confirm the recent clinical observations (10) that the surgical removal of all available tumor tissue in a seemingly hopeless case serves to prolong the individual's life for several years. Further no untoward effects are recorded by cutting into the tumor mass or by severing lymphatic channels. A survey of these reports and a study of the data reported here would suggest that the treatment of a neoplasm is facilitated by the removal or destruction of any quantity of the growth and that the hosts' survival is, thereby, proportionately prolonged.

SUMMARY

1 Rats bearing transplanted fibrosarcomas, adenocarcinoma, and squamous cell cancer were operated upon and compared with an un-

operated upon control series for length of survival after transplantation and percentage in which metastases were detected.

2 The average survival period of rats bearing transplanted fibrosarcomas was significantly prolonged by excision of the tumor 9 days after transplantation but the percentage of lung and lymph node metastases was not altered.

3 The average survival period of rats bearing transplanted adenocarcinoma was significantly prolonged by the removal of a considerable mass of the tumor 60 days after inoculation. The rats operated upon which survived the rats of the control series had a significantly higher percentage of lung metastases.

4. A simple biopsy performed on rats bearing transplanted adenocarcinoma did not affect the average survival period of the rats or increase the percentage with lymph node and lung metastases.

5 A simple biopsy of transplanted squamous cell cancer did not affect the average survival period of the rats or increase the percentage of metastasis to the lymph nodes, lungs, and skeletons.

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CHRONIC OSTEOMYELITIS COMPLICATING WAR COMPOUND FRACTURES

An Evaluation of 125 Patients Treated by Early Secondary Closure

THOMAS HORWITZ, M.D., F.A.C.S., Colonel M.C. A.U.S. Ventnor New Jersey and
RICHARD G. LAMBERT, Captain, M.C. A.U.S., Hines, Illinois

THE remarkable success observed following delayed primary closure of war wounds on or after the fourth day following initial débridement and of late secondary closure following excision, either by direct suture or closure with skin flaps or grafts (Churchill) stimulated our efforts toward early closure of wounds in the treatment of chronic osteomyelitis complicating war compound fractures. We adopted a plan of conservative osteotomy followed by wound closure on the fifth postoperative day in cases in which such closure was mechanically possible and appeared warranted and penicillin was used both systemically and locally.

Observations, herein recorded and initiated September 15, 1944 have been directed toward answering the following questions:

1. What is the value of penicillin systemically and locally, in war osteomyelitis?
2. What is the optimum time for osteotomy?
3. What shall be the extent of the osteotomy?
4. What is the value of early secondary wound closure not only in diminishing the immediate convalescent period with a minimum amount of scarring and deformity but in preparing the field more adequately and more quickly for definitive reconstructive work, when such surgery will be necessary?

On our service we have accepted a minimum waiting period, following cessation of all drainage, of 3 months prior to definitive soft tissue reconstructive surgery and of 6 months prior to reconstructive bone surgery and we are convinced, following our own experience and that of others that shorter periods invite an

increased incidence of recurrent infection. Despite our anxiety to reduce this time factor we do not accept the method of widespread extirpation of soft tissue and bone recently advocated in the treatment of war osteomyelitis, as the drive to eliminate infection surgically appears greatly to exaggerate the already existing soft tissue and osseous reconstructive problems (Kelley Rosati and Murray).

TECHNIQUE

Soft tissue is not sacrificed indiscriminately. The sinus tract and necrotic skin margins are excised and the osteotomy is limited to the removal of bone that is obviously dead and detached. Any bone that appears viable is spared. Sharp edges and prominences are not removed except when they might interfere with wound closure.

The skin is undermined freely. In some cases this procedure has been carried to fully one-half of the circumference of the extremity. However, there has been no spread of infection by such extensive dissection. It often permits complete skin closure or at least a considerable diminution in the size of the wound gap. Mattress sutures of silkworm gut or wire are used in conjunction with buttons to prevent cutting in of the skin. The upper and lower portions of the wound are closed and the central portion is left open; one or two sutures being placed in readiness for closure on the fifth postoperative day.

A vaseline gauze or rubber drain is inserted into the depths of the central portion of the wound and plaster of Paris fixation is applied. Usually the posterior one-half of the previous cast is utilized and completed with a few circular bandages. On the fifth postoperative day the drain is removed through a fenestrum and the sutures are closed if the appearance of

Presented before the Chicago Orthopedic Society at Vaughan General Hospital on April 13, 1945, and at the Surgical Conference of the Sixth Service Command in Chicago, Illinois, on July 27, 1945.

SURGERY GYNECOLOGY AND OBSTETRICS

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TABLE I.—SERIES A. ANALYSIS OF 75 PATIENTS TREATED WITH SYSTEMIC AND LOCAL PENICILLIN

Postoperative drainage Duration	Completely healed wounds		Involvement	No.
	No. patients	Boone		
10 days	6	Tibia		33
30 days	14	Tibia, fibula		3
6 weeks	7	Fibula		6
2 months	14	Femur		5
3 months		Metatarsal		4
4 months	6	Mim		5
5 months	5	Os calcis		1
6 months	2	Astragalus		1
7 months	4	Cuboid		1
8 months		Radius		1
9 months	1†	Humerus		1
9 months	1‡	Metacarpal		1
Total	73			
Persistent drainage				
7 5 months	1	Neck of femur and hip joint; reoperation 8-17-45		
8 months		Upper tibia and knee; probable reoperation		
Total	2*			

*Lower femur and knee joint

†Lower tibia and ankle joint

‡Os calcis, reoperation and healing 18 days later

§Both os calcis drained 10 2 months after reoperation

The wound warrants it These sutures are removed on the tenth postoperative day and the cast is closed for 1 month. Subsequent external fixation will depend on the appearance of the wound and the progress of bony union.

Femur cases are returned to balanced suspension with skeletal or skin traction depending on the state of bony union.

In cases in which complete skin closure has not been possible or advisable, healing of the residual skin defect has been materially hastened by the early application to receptive surfaces of either split skin grafts or large pinch grafts.

There have been some cases with extensive loss of soft tissue in which this method of delayed skin approximation has not been applicable. Here the extensive surfaces have been covered, even in the presence of considerable drainage, with intermediate skin or pinch grafts. In some of these cases, in which the defect has existed over bony prominences or easily traumatized areas or in the preparation of the field for definitive reconstructive measures, more adequate skin coverage has been

found necessary following this temporary skin dressing.

Dose of penicillin Systemic. Penicillin has been employed intramuscularly in 15,000 to 30,000 unit doses every 3 hours beginning at 6:00 p.m. on the evening prior to surgery and has been continued postoperatively for a minimum of 10 days. Total dosage has varied from 1,200,000 units, in mild and moderately severe cases, to 2,400,000 units in the severe cases of osteomyelitis. More recently a uniform dosage of 40,000 units every 4 hours has been adopted (Keefer *et al*). Our patients have invariably preferred periodic intramuscular injections to continuous administration by vein or muscle. The antibacterial agent was discontinued in 6 patients because of severe skin reactions, without mishap and there were 3 instances in which a clinical picture of nonspecific reaction was manifest toward or shortly following the completion of the course of penicillin—reactions attributed to impurities in the commercial preparations.

Local. Penicillin instilled in 20 cubic centimeter doses 3 times daily (250 units per c.c. of sterile water) was employed in the first group of 75 cases, a $\frac{3}{4}$ inch rubber tube having been introduced through a stab incision into the depths of the wound. This treatment was eliminated in the second group of 50 cases for purposes of comparison.

EVALUATION OF CLINICAL MATERIAL

Series A consists of 75 cases of chronic osteomyelitis treated by osteotomy and delayed closure and the use of penicillin, both systemically and locally between September 15 1944 and March 1 1945 and evaluated up to September 15 1945 (Table I).

Of this group in 73 patients (97.2%) the wounds are completely healed while in only 2 cases (2.8%) are they still draining. It will be observed that in 41 cases (54.7%) healing was complete within 2 months and that wound healing occurred in another 31 cases following drainage periods up to 9 months a total of 73 healed without reoperation. One patient with involvement of the os calcis was reoperated upon following a 10 month postoperative drainage period. Several well localized sequestra were removed the cavity walls col-

TABLE II—SERIES B. ANALYSIS OF 50 PATIENTS TREATED WITH SYSTEMIC BUT NO LOCAL PENICILLIN

Completely healed wounds			
Postoperative drainage	No. patients	Involvement	No.
Duration		Bone	
10 days	13	Tibia	14
30 days	21	Femur	6
6 weeks	7	Femur (great trochanter)	2
3 months	5	Humerus	6
4 5 months	1	Humerus	4
		Radius and ulna	2
		Radius	2
		Ulna	2
		Fibula	1
		Os calcis	2
		Metatarsal	2
		Tarsus	2
		Scapula	1
Total	46		
Persistent drainage			
4 months	1	Tibia, knee joint	
3 months	1	Os calcis	
2 months	1	Femur	
6 weeks	1	Tibia, knee joint	
Total	4		

lapsed, and the wound healed 10 days later. Of the 2 patients with persistent drainage following initial osteotomy one with a localized osteomyelitis of the femoral neck has been reoperated upon 7 5 months later while the other with extensive infection in upper end of tibia and knee joint draining 8 months after operation may require a second osteotomy.¹

Cases of osteomyelitis at the ends of long bones with adjacent joint involvement have proved to be very recalcitrant. In one patient with chronic infection at the distal end of femur and involvement of the knee joint healing occurred after 8 months of postoperative drainage. In another with involvement of distal end of tibia and ankle joint healing was complete 9 months postoperatively.

Series B consists of 50 patients treated in like manner but without local penicillin. Ten patients were operated on between September 15 1944 and October 15 1944 and the remaining 40 between April 14 1945 and July 6 1945, all have been evaluated up to September 15 1945 (Table II). In this series B, wounds are completely healed in 46 (92%) patients, and in only 4 (8%) are they still draining. It

TABLE III—ANALYSIS OF 73 PATIENTS WITH HEALED SOFT TISSUE WOUNDS (SERIES A)

Time required for wound healing after osteotomy	No. patients	Average period of preoperative drainage months	Union	Large defect	No. amputations
days	6	6 5 (4 to 7)	6		
to 30 days	4	5 (4 to 7)	14		
6 weeks	7	4 7 (4 to 7)	7		
3 months	4	3 8 (3 to 5)	8		6
3 months	1	4 (3 to 5)	3	1	4
4 months	6	4 (3 to 6)	4	3	
5 months	5	4 (3 to 5)	4		
6 months	1	5			
7 months	4	4 (3 to 5)	4		
8 months	1	4	1	1	
9 months	1	4	1	1	
11 months	1	4	1		

will be noted that in 45 cases (90%) healing was complete within 2 months after operation.

No significant information has been obtained in an evaluation of the theaters of operations from which our patients have been derived. This observation also applies to the bacterial growths obtained from the wounds which revealed several types of penicillin sensitive staphylococci and/or streptococci, with a variety of other organisms which were often insensitive to penicillin. The latter groups did not appear to inhibit wound healing materially, although contributing to the amount and odor of drainage, and they tended to disappear as healing progressed.

EVALUATION OF STUDY

1. *Value of penicillin.* A comparison of the progress of wound healing in those patients treated early in Series A in whom penicillin was first employed very cautiously and in total doses from 250 000 to 750 000 units, with those treated later with more adequate total doses (1 200 000 to 2 400 000 units) has convinced us that penicillin, systemically administered is of definite benefit in the treatment of this type of chronic osteomyelitis. Although our operative technique has not varied in these cases there are other variable factors present which make the evaluation of penicillin a purely relative one and not accurately measurable viz. the duration of pre-

¹ Both cases ceased draining in 3 months following reoperation. In other words, healing has occurred in all 28 cases, or 96 per cent.

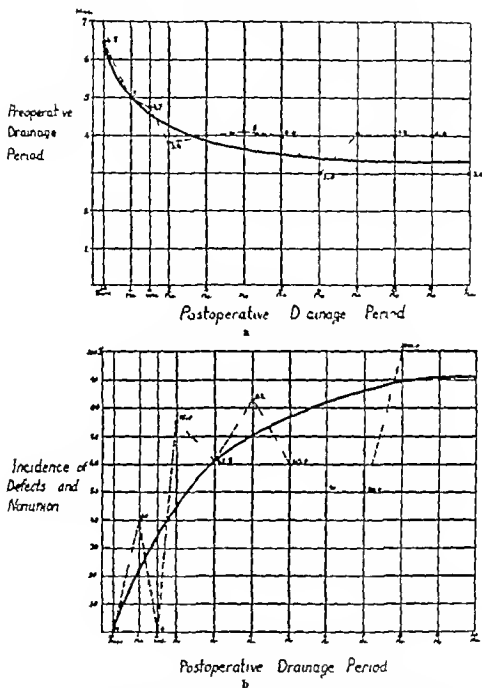


Fig. Analysis of 75 cases of chronic osteomyelitis with healed soft tissue wounds (series A). a, Relation between preoperative and postoperative drainage periods. b, Relation between postoperative drainage period and large bone defects and/or nonunion.

operative delay the severity and extent of the fracture and of the complicating infection and the anatomic site of the infectious process.

It is believed from a comparison of Series A and B that the local use of this agent has not served materially to alter the progress of

wound healing and for this reason its local use has been discontinued. Thus the nursing problem required by repeated local instillations is eliminated.

2. *Optimum time for osteotomy.* The value of adequate preoperative delay. Our patients have

often required whole blood for secondary anemia and a diet high in protein and vitamin C. Extensive drainage has been materially lessened during this waiting period by a preliminary course of penicillin. Elevation of the affected extremity has diminished edema and simple exposure of the wound has served to improve the condition of the soft tissues which are often macerated and inflamed from prolonged exposure to drainage. Adequate preoperative delay which has been tolerated well in all instances, not only encourages improvement in the patient's general condition but insures more accurate delimitation of the infection and permits progress of bony union.

A study of the figures in Table III and of the graphs in Chart 1 demonstrates a striking relationship between the duration of the preoperative and the postoperative drainage periods and the incidence of large bone defects and/or disturbances of bony union.

In an analysis of the 73 healed cases in Series A, most rapid postoperative wound healing (10 days) occurred in those with the longest preoperative delay (average 6.5 months). This must, therefore, be interpreted as the optimum waiting period in this series. It will be observed that *as the period of delay prior to osteotomy has lessened the period of postoperative drainage has lengthened and the incidence of bone defects and of nonunion has mounted*. In other words adequate preoperative delay encourages a shortening of the postoperative drainage period which means lessened soft tissue scarring. It also ensures more accurate delimitation of the bone infection which in turn permits easier definition and less sacrifice of bone by the surgeon at the time of osteotomy, less residual bone defects and a greater likelihood for firmer bony union.

It may be argued that, for example, a preoperative waiting period of 2 months with postoperative drainage for 4 months represents no greater loss than a 4 month waiting period with only 2 months of postoperative drainage. This is far from true for the case with the shorter postoperative period of drainage will show healing of soft tissues with less scarring, will probably have had less bone sacrifice at the time of sequestrectomy and bony union will be more secure.

3. Extent of osteotomy. Conservative bone excision. Only bone that is obviously dead and detached is sacrificed. Prominences and irregularities are not removed except when they may interfere with wound closure. Protruding bone is excised to the level of the surrounding granulation tissue. Bone thus spared may aid materially in diminishing the problems of bone defects and of delayed union. The wisdom of this attitude is exemplified in an early group of patients in Series A in whom all apparently infected bone was resected boldly, with resultant bony gaps, shortening and deformity, and with prolonged drainage notwithstanding and who have been faced with extensive programs of reconstructive surgery. We dislike the term 'saucerization' in the surgery of these cases for the creation of a saucer like topography of necessity implies the sacrifice of adjacent normal bone and the exaggeration of pre-existing defects.

We have observed that extreme conservatism must be exercised particularly in the excision of bone in certain regions, as for example in the lower end of the femur, the upper end of the tibia and in the os calcis. Indiscriminate resection because of the lack of adequate bone reformation in these particular areas serves to create considerable reconstructive problems, prolongs convalescence and delays functional restoration. We have observed a number of these cases given sufficient time, fill in spontaneously with scar, while the residual column of bone has been sufficiently sturdy to assume adequate functional responsibility. Thus far only 2 patients with upper tibial defects will require plastic reconstructive measures of any magnitude. Collapse of the walls and elimination of the cavity appear worthwhile in selected instances of chronic osteomyelitis of the os calcis.

A few areas of which the ilium and fibula are examples, lend themselves very well to a liberal extirpation of involved bone since this sacrifice leads to no disability whatever yet often ensures successful delayed closure.

4. Value of delayed wound closure. The extensive undermining of skin performed to permit a complete or partial closure following osteotomy has not resulted in the spread of infection in any instance. This procedure

offers a rapid method of closure with adequate skin, lessens the need for skin plastic measures, ensures less scarring and a more satisfactory bed for reconstructive surgery of underlying muscle tendon nerve and bone.

CONCLUSIONS

1 Penicillin, administered systemically in adequate doses, is of value in the treatment of chronic osteomyelitis complicating war compound fractures. Its local use has not assisted materially in wound healing and has been discontinued.

2 The purpose of early skin closure following osteotomy in the treatment of war osteomyelitis is to encourage healing of these wounds with the least amount of scarring and deformity. This result is obtained most ideally when the skin flaps may be coaptated directly as herein described.

3 Adequate preoperative delay ensures a more accurate delimitation of the infectious process. This serves to lessen the amount of bone that need be sacrificed at the time of osteotomy and allows for progression of union at the fracture site for if this is secured

the treatment of the osteomyelitis becomes considerably simplified.

4 These factors—the healing of soft tissues with the least scarring and deformity, the sacrifice of the least amount of bone and the occurrence of union at the fracture site—all serve to lessen some of the more complicated problems in the reconstructive surgery of extremity war wounds.

It is our firm belief and our statistics bear this out that the conservative approach herein described assures greater likelihood for the satisfactory control of war osteomyelitis with the least sacrifice of soft tissue and bone. Other methods in use elsewhere where the drive to eliminate infection carries with it the wide spread extirpation of soft tissue and bone, serve to exaggerate and complicate the reconstructive problems already present in these cases.

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PERSISTENCE OF THE VITELLINE (OMPHALOMESENTERIC) ARTERY AS A CLINICAL PROBLEM

H. G. SMITHY M.D., and J. ALLEN CHAMBERLIN M.D. Charleston South Carolina

DEVELOPMENTAL anomalies originating in the embryonic vitelline or omphalomesenteric structures are predominantly those associated with Meckel's diverticulum. Much less common than persistent elements of the vitelline ductal system are anomalies arising from the vitelline vascular system. Despite their rarity, persistent omphalomesenteric vascular remains were recognized and described in the latter part of the eighteenth century. That they may be of singular importance as a clinical problem is attested by the ensuing discussion.

EMBRYOLOGY

Review of the embryologic development and consequently of persistent anomalies of the vitelline (omphalomesenteric) circulation begins with consideration of the yolk sac. In the human embryo the yolk sac sometimes called the umbilical vesicle is demonstrable in the earliest known specimens i.e. at the end of the second week (11). Its nutritive function is probably of minor significance but its endodermal lining gives rise to the mucosal epithelium of the major part of the digestive tract while the mesodermal layer of its wall is the site of early development of blood cells and vascular channels (1, 3). Primitive blood islands of the vascular anlage have been demonstrated in the mesodermal layer of the yolk sac wall of the Peters and von Spee embryos (13½ to 18 days of age, 12). As the yolk sac enlarges and as the primitive gut develops the two structures become connected to one another by the so called yolk stalk, or vitelline (omphalomesenteric) duct, which elongates as the embryonic body increases in size. Subsequently the yolk sac atrophies and the vitelline duct becomes incorporated into the umbilical cord. It detaches itself from the gut during the sixth week of intrauterine life. Normally the duct degenerates after its detachment. However persistence of its intra-abdominal portion occurs in 2 to 3 per cent of cases, manifesting itself definitively as the familiar Meckel's diverticulum of the ileum.

Like the vitelline duct, existence of the vitelline circulation is transient. At the fifth week of in-

trauterine life the omphalomesenteric artery is the most prominent ventral branch of the aorta. It arises from the latter by several roots and passing ventrally toward the umbilical cord divides to surround the primitive gut by an arterial ring at the point of junction of the gut with the omphalomesenteric duct (Fig. 1). In its subsequent course, it is paired so that two vitelline arteries are identifiable in the early embryo (5 weeks). The paired vessels leave the embryo accompanied by the vitelline duct and are distributed as a ramifying plexus over the surface of the yolk sac. Coincidentally with atrophy and degeneration of the yolk sac, one of the paired vitelline arteries disappears. The remaining one develops further and comes to lie in the mesentery of the midgut, supplying the latter with blood and becoming definitively the superior mesenteric artery (Fig. 2). According to Cullen its connection with the umbilical cord may persist long after the vitelline duct has disappeared, which normally occurs at approximately the sixth week of intrauterine life. Whatever may be the temporal relationship the vitelline artery normally loses its umbilical attachments to remain as the superior mesenteric artery.

The vitelline veins arising in the wall of the yolk sac, are paired. The two vessels enter the abdominal cavity of the embryo at the umbilicus accompanied by the vitelline artery and duct. From the umbilicus the two venous trunks course cephalad, following the path of the gut to empty into the primitive heart. At the fifth week of embryonic development, the liver bud begins to expand and interrupts the vitelline veins in their course toward the heart. One of the vessels becomes incorporated for the most part in the growing hepatic sinusoidal system while the other atrophies and disappears. The surviving vessel receives the superior mesenteric vein and the splenic vein just before entering the liver and becomes finally the portal vein.

CLINICAL SIGNIFICANCE

Persistence of the omphalomesenteric artery manifests itself anatomically as an adventitious intra-abdominal cord covered by peritoneum. Usually it is attached firmly at its two extremities

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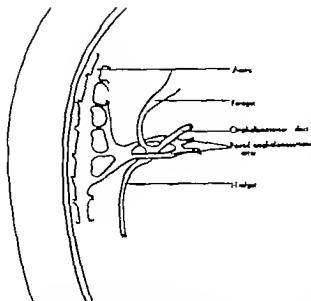


Fig. 1. Origin of paired omphalomesenteric arteries from primitive aorta in the early embryo (5 weeks). Note relationship to junction of the omphalomesenteric duct and intestine.

one to the anterior abdominal wall at the umbilicus and the other to the mesentery of the terminal ileum. By such an arrangement there is formed a tense band traversing the abdominal cavity in an anteroposterior direction. Its potential danger as a source of intestinal obstruction is obvious. Persistent vitelline arterial remnants may be associated with a Meckel's diverticulum, in which

instance a free band is formed connecting the diverticular mesentery to the umbilicus or to the ileal mesentery. The resulting anatomic arrangement is a ring or loop through which coils of intestine may pass to become strangulated. The least common form of persistent vitelline artery is that situation in which the vascular remnant is attached only at its mesenteric end, the remainder of the vessel hanging free in the abdominal cavity.

Clinically it is significant that only 4 cases of persistent omphalomesenteric artery producing no symptoms have been reported. Of these only one was an adult, a dissecting room cadaver studied by Derbes and Hoge, showing both persistent artery and Meckel's diverticulum; the case record contained no mention of abdominal discomfort during life. The others were infants examined at autopsy, 2 of whom the anomalous vessels were unattached at one end hanging harmlessly free in the abdomen (Meckel and Ruge) while the third was a newborn child found to have both mesenteric and umbilical attachments intact (Geail). Inasmuch as 3 of the asymptomatic patients were infants it is striking that the literature provides only one adult patient showing no clinical disturbance as a result of persistence of the vitelline artery.

Table I contains a summary of the literature of 12 cases of persistent vitelline artery in which disturbing clinical symptoms were present. Nine of the cases terminated fatally, a mortality rate of 75 per cent. All but one of the deaths were due to acute intestinal obstruction. The remaining fa-

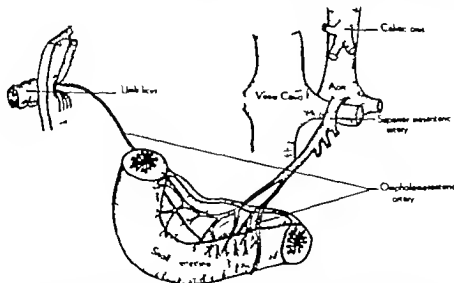


Fig. 2. Semidiagrammatic representation of relationship of persistent omphalomesenteric artery to superior mesenteric artery (term). Normally the omphalomesenteric vessel loses its umbilical attachment before term.

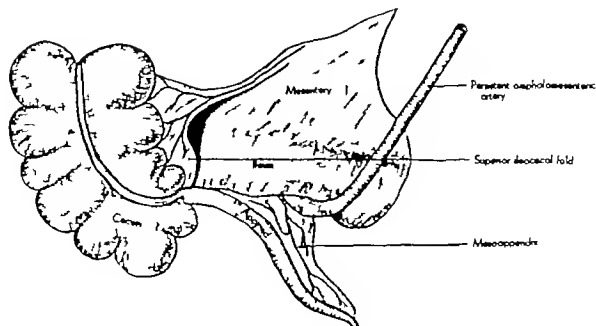


Fig. 3.

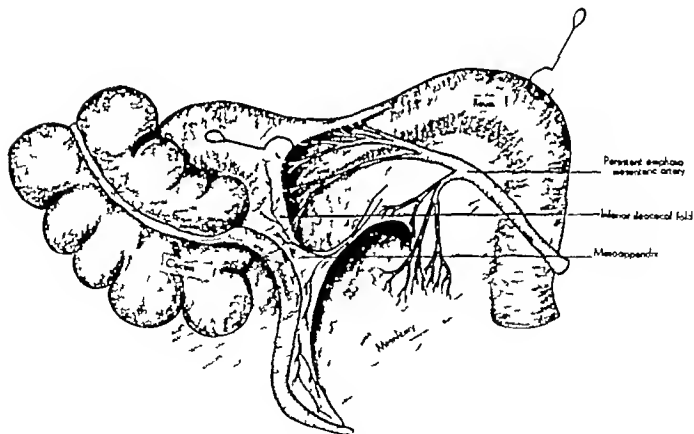


Fig. 4

Fig. 3 The relationship of persistent omphalomesenteric artery to ileum and cecum as seen at the time of operation

Fig. 4. Ileum retracted upward showing terminal branches of persistent omphalomesenteric artery entering mesentery

talities occurred in a child 4 months of age as a result of hemorrhage from a branch of the persisting vitelline artery. This patient recorded by

Fraser and McCartney presented a small area of granulation tissue in the umbilicus. Actual cauterization of the granulating surface was

examination were confirmatory of a diagnosis of acute intestinal obstruction. Exploration of the abdomen revealed a stout cord attached at the umbilicus and passing posteriorly to disappear in the retroperitoneal tissues just below the third part of the duodenum. In its course, the cord had encircled a segment of intestine causing complete obstruction of the closed-loop type. The patient died on the fifth postoperative day. Histologic studies confirmed the presence of venous elements in the adventitious band.

CASE REPORT

Roper Hospital No. 39778. A Negro laborer 35 years of age was admitted to the hospital June 30, 1945, complaining of abdominal pain of 6 months duration. He stated that his pain was intermittent in character, located in and around the umbilicus and in the epigastric midline between the xiphoid and the navel. The pain was exacerbated by erect, standing, walking, straining, coughing, and remaining relieved by reclining. For this reason, the discomfort was noticed rarely at night. Near the end of a day's work, the patient revealed that the pain was at its worst and that vomiting occasionally occurred under such circumstances. There was no radiation of the pain and it was not influenced by eating or hunger. There was no history of hematemesis, bloody or tarry stools, jaundice, constipation, or diarrhea. History of the other body systems was noncontributory.

Physical examination revealed the following: temperature, 98.6°; blood pressure, 124/75; pulse and respiration normal. The patient was well developed and well nourished. Abdomen was flat and moved with respiration. There was no distention, muscle spasm or rigidity and no masses were palpable. Tenderness was present on pressure upon the right upper quadrant, but was not excessive rebound pain was absent. On auscultation, peristalsis was audible and of normal character. Rectal examination was negative. Remainder of examination showed only irrelevant findings.

Laboratory studies showed white blood cell count 9,500 with normal differential count, hemoglobin, 18 grams. Urinalysis showed normal urine. Analysis of gastric contents showed normal findings. X-ray of gastrointestinal tract after ingestion of barium showed no abnormalities. Blood Wassermann and Kline tests were negative.

A specific diagnosis was not made but in view of the persistent nature of the patient's discomfort and because he was incapacitated by his illness, laparotomy was done 5 days after admission.

Under spinal anesthesia, the patient's abdomen was entered through a right paramedian incision. A firm, extremely taut fibrous cord, covered by peritoneum, was found attached at one extremity to the under surface of the umbilicus and at the other to the mesentery of the terminal ileum 3 centimeters from the ileocecal junction (Fig. 3). The band did not enter the lumen of the ileum. Dissection at the mesenteric attachment revealed the terminal portion of the cord to fan out into numerous small, fibrous, filamentous strands which lost themselves between the two leaves of the mesentery (Fig. 4). The main cord looped over the ileum to the left of the latter in such a way as to support in part the weight of the terminal ileum and cecum when the patient was erect (Fig. 3). However, there was found to be no agglutination of the ileal serosa to the covering of the adventitious band so that there was no evidence of obstruction or compression of the intestine. Furthermore, the cord

was not adherent to any other viscera along its course to the umbilicus. Traction upon the anomalous structure at its ileocecal extremity caused dimpling and inversion of the umbilicus as observed from without. Further exploration revealed no abnormalities of the abdominal viscera. There was no Meckel's diverticulum. The cord was clamped and ligated at its two extremities and excised in its entirety. After removal of the appendix, the abdomen was closed in layers.

Follow-up examinations at 4 and 10 weeks after operation have found the patient to be entirely free of pain. He has returned to work and is considered to be cured.

Pathologic examination of the removed specimen, which measured 9 centimeters in length, revealed a tough cord selected from various segments of the cord, demonstrated centrally located, thick walled, patent artery surrounded by a zone of loose fibrofatty tissue a layer of more compact subserosal areolar tissue, and an external covering of serosa (Fig. 5). Higher magnification of the central artery showed a well defined internal elastic lamina and a patent lumen containing red blood cells, some of them in rouleaux formation (Fig. 6).

The occurrence of abdominal pain in this patient was apparently on a mechanical basis. Review of Figures 3 and 4 explains the traction type of discomfort which was noticed only when the individual was standing erect. In this position the gravity effect was such that the full weight of the cecum and, most probably several loops of small intestine, in addition to the terminal ileum, was exerted upon the adventitious band. This in turn produced traction upon the peritoneal surface of the umbilicus. In the recumbent position tension of the cord was reduced materially and the umbilical traction eliminated. Vomiting, which was said to occur at the peak of intensity of the pain, was more likely of the reflex origin, due to traction upon the periumbilical parietal peritoneum, than to actual obstruction of the bowel.

Of interest is the fact that no symptoms referable to the abdomen occurred until the patient was 35 years old. While difficult to explain, it is significant that the patients reported by Mahomed and by Buchanan and Wapshaw developed their first symptoms after 18 and 12 years respectively. Postoloff's case was 36 years old before noticing abdominal discomfort. On the contrary Shaw's patient, who was 43 years of age, had suffered from lower abdominal pain since childhood.

Intestinal obstruction is the most common (and most serious) complication of persistent omphalo-mesenteric vessels. That no evidence of ileus was found either at operation or in the patient's history may be regarded as coincidental. In respect to the production of symptoms by vitelline vascular remains in the absence of mechanical obstruction, the case is similar to those reported by Shaw and by Gautier. It is probable that intestinal obstruction would have supervened

eventually if the adventitious band had not been removed

SUMMARY

- 1 The embryologic development of the vitelline vascular system is reviewed briefly
- 2 A review of the literature of persistent vitelline vascular elements is presented in tabulated form and their clinical significance discussed
- 3 A case of persistent vitelline artery causing disabling symptoms which were relieved by operation is reported.

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A STUDY OF THE EFFECT OF PROPHYLACTIC ORAL SULFADIAZINE UPON INFECTION IN SOFT TISSUE WAR WOUNDS CLOSED SECONDARILY

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THE well controlled statistical studies of Meloney and his associates has cast serious doubt upon the efficacy of systemic sulfonamides in preventing infection in traumatic wounds. This present study on the other hand, although dealing with a somewhat different problem, indicates that sulfadiazine, given orally at secondary closure of soft tissue war wounds, reduces the incidence of infection and is associated with better healing.

The multiplicity of factors involved in wound healing makes the critical evaluation of any one factor difficult. It is difficult to carry out controlled and impartial experiments in a laboratory; the problems are greatly increased when one deals with patients rather than guinea pigs and under war conditions it may at times appear impossible to obtain sufficiently accurate and detailed records, or observe the patient long enough to assess results. Furthermore, in the treatment of battle casualties the emphasis is upon producing the best immediate results by any and all means—a relatively innocuous drug like sulfadiazine is likely to be freely used if it promises any conceivable benefit to the patient, rather than withheld in selected cases to help determine its true value.

In the treatment of the 200 soft tissue wounds which form the basis for this study it must be admitted at the outset that the aim was to procure the best possible results in each case, and not to conduct an experiment on the prophylactic value of sulfadiazine. The situation has been further complicated by the fact that in some instances penicillin as well as sulfadiazine has been employed prophylactically (Penicillin was not available for routine use in the light injuries which constituted most of the wounds.) Nevertheless, the very fact that wounds which promised difficulty were treated with prophylactic sulfadiazine, lends weight to any differences which can be shown to favor the sulfadiazine treated group since it may be assumed that the bulk of the worst wounds will be included there.

It is perhaps worth mentioning at this point that little was expected from sulfadiazine as a prophylactic when the series was begun. In common with many other surgeons we regarded it with a skeptical eye. It was first used in those patients who had wounds which promised trouble (as in deep wounds, or wounds which closed with considerable tension) or in whom good healing was of particular importance (as in wounds with associated damage of a peripheral nerve). Stock was taken after 150 wounds had been closed and the value of the drug appeared sufficiently established to warrant its routine use.

It might seem from the difficulties detailed in the foregoing paragraphs that no valid conclusions could possibly be drawn in this report. Some advantage may derive from the fact, however, that the series is both consecutive and in every sense a personal one. The writer supervised the preparation of the wounds for closure, employed a uniform technique in operating upon them and personally observed their postoperative course. This at least eliminated the inevitable differences in judgment between individuals as to when a wound is ready to close, how it should be closed, and what constitutes a wound complication.

MATERIAL AND METHODS

Material. The series consists of 200 consecutive personally performed secondary closures upon soft tissue wounds in 131 soldiers. 40 of the wounds were in 39 German prisoners of war. 151 wounds were caused by high explosive fragments. 47 wounds were caused by bullets, and 3 by non-battle trauma. The wounds were all incurred in France and Germany between August, 1944, and April, 1945. In all but 7 wounds, preliminary debridement was carried out in forward hospitals and the patients transported to this general hospital anywhere from 1 to 25 days after the debridement. Compound fractures were excluded from the series, as were wounds in certain patients being promptly evacuated for other conditions (such as cerebral injury) which precluded a satisfactory period of observation. During this entire time it was the fixed policy of the surgical service

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to close either by suture or graft all wounds at the earliest practicable time. Recognized exceptions were wounds so small that they could be expected to heal spontaneously within 2 weeks, deep wounds with small openings, wounds presenting severe and persistent infection (not more than 2 or 3 wounds were excluded for this last reason during the entire period). In general closure was preferred to grafting whenever it could be effected.

Ninety three wounds represent a consecutive series for the entire hospital that is, every secondary closure performed in the hospital was carried out by the writer during this time, to prevent an artificial selection of easy cases for the series. (Actually all wounds which promised difficulty in closure have been consistently turned over to the writer because of his interest in the problem.) The final results in the entire series are comparable to other published series of secondary closures. Seventy-eight per cent of the wounds were solidly healed in 2 weeks or less.

Preparation of the wound. The appropriate time for closure was determined by the gross appearance of the wound. No closure was performed at the first dressing but wounds which were clean when first seen were closed after a day or two of saline or azochloramide dressings. Wounds which were dirty or infected were treated with meticulous dressings of 1:3000 aqueous solution of azochloramide once or twice daily at which time slough was picked off. Debridement was necessary followed by secondary closure a few days later. Edema or induration at the wound edges was permitted to subside. Once the wound was grossly clean secondary closure was carried out. In some wounds appreciable delay in closure and even in the start of systematic preparation took place because of the press of more urgent work.

Operative procedure. The procedure carried out depended entirely upon the physical character of the wound and fell roughly into one of three general types. In those wounds supple enough to permit it (chiefly those received within 10 days of debridement) a simple closure was performed with widely spaced deeply placed vertical mattress sutures of silk usually a heavy silk suture were not burned. Heavily scarred wounds were carried out *en bloc* and closure carried out with buried sutures of fine silk or cotton to the skin. There was an intermediate group in which there might be undermining of skin edges, or excision of exuberant granulation tissue, or modification of

TABLE I.—WOUND COMPLICATIONS
Wounds having more than one complication have been listed here only once under the most serious. Any infection has been given priority over any technical complication

	Number	Total
Uncomplicated healing	11	57
Infection	5	
Mild stitch abscess	23	
Moderate cellulitis	3	
Stitch abscess	6	
Severe cellulitis	4	53
Wound abscess	5	
Infection with lymphatic spread	4	
Infection (after apparent healing)	27	
Late infection (after apparent healing)	6	
Non-infections or technical complication	7	800
Separation at suture line	8	
Sinus from drains	2	
Cutting sutures	2	
Mild induration	1	
Hematoma		
Dehiscence from tension		
Dehiscence from unobliterated dead space		

the shape of the wound to facilitate closure, these have been grouped as *wound revision*. In this group buried sutures of fine silk or cotton might or might not be used. Catgut was not used in any wound. In an occasional wound with marked tension retention sutures over gauze pledgets were employed. In some of the wounds treated early in the series, sulfanilamide powder was lightly dusted into the wound this was discontinued later. There were no instances of so-called 'partial closure in this series.

Chemotherapy. The usual scheme for the employment of sulfadiazine as a prophylactic was to begin it as soon after the secondary closure as the patient could take it. 4 grams was given as an initial dose and this was followed in an hour by a 1 gram dose after which he received 1 gram every 4 hours for 6 days. The penicillin dosage was 20,000 to 30,000 units intramuscularly every 3 hours for 2 to 5 days. Nine patients with 19 wounds were given sulfadiazine before as well as after closure, 2 patients with 3 wounds received penicillin as well as sulfadiazine before and after. These are not treated as a separate group since any advantage possibly resulting from the pre-closure use of sulfadiazine is still a feature of its prophylactic value. There were only 2 instances of untoward reaction to sulfadiazine—both febrile—among the 92 patients who received the drug.

Postoperative care. In general, patients who had wounds of the lower extremity were kept in bed until healing was sound. Splints were freely employed. Sutures were removed from the sixth to tenth day depending upon the appearance and

TABLE II—INCIDENCE OF INFECTION AND DELAYED HEALING (15 DAYS OR MORE) IN WOUNDS GROUPED BY FACTORS ACTING PRIOR TO SECONDARY CLOSURE

Factor	Total wounds	Infection			Delayed healing		
		Number	Per cent	Significant difference	Number	Per cent	Significant difference
All wounds	308	57	39	—	44	33	—
All wounds excluding 3 technical failures	297	57	39	—	45	—	—
Cause of wound							
Bullet	47	3	3	No	9	9	No
High explosion	43	44	39		3	—	
Other	—	—	—		—	—	
Type of wound							
Penetrating wound	7	3	99	Yes	3	3	No
All others	30	34	3		41	7	
Size of wound							
Large*	36	33	33	No	3	3	No
Small	90	22	23		3	39	
Nationality							
German prisoner	25	3	8	Yes	3	34	Yes
U.S. soldier	29	34	—		41	18	
Time of debridement from injury							
24 hrs. or less	—	—	30	No	29	—	No
3 hrs. or more	35	3	7		—	—	
Chemotherapy at time of injury							
Known or questionable	34	8	39	Yes	3	34	No
Sulfadiazine ± Penicillin	83	5	39		3	31	
Delay—debridement to closure							
10 days or less	94	7	39	Yes	14	3	No
15 days or more	106	29	35		27	3	
Preparation of wound at general hospital							
10 days or less	129	—	—	Yes	26	39	No
15 days or more	27	26	45		3	26	

*Large wounds: those 6 cm. or more in length, or 3 cm. or more in width

location of the wound emphasis was placed upon supporting the suture line with adhesive strapping (which was often applied immediately after operation as well). Sulfadiazine was employed therapeutically in 7 instances, and penicillin in 4 instances after infection had appeared in a wound. Their use in these cases has not been regarded as prophylactic although they may have contributed to the swifter healing of the wound. In 1 case particularly penicillin appeared to abort a serious cellulitis.

Appraisal of complications. This feature of the study is of paramount importance. Ideally a single person, other than the surgeon, should follow all the wounds, since surgeons are some times reluctant to see blemishes in their own handiwork. Unfortunately this ideal arrangement could not be followed but the writer made an honest effort to be both strict and uniform in

applying criteria of wound healing and to note even the most minor complications. Some evidence of strict interpretations is to be found in the fact that although 78 per cent of the wounds were healed in 2 weeks or less, 55 per cent are listed as having a complication of one sort or another (Table I).

Complications were recognized as of two general types: technical and infectious. A heavy line may separate a "cutting suture" from a "mild stitch abscess," or "induration" (as seen in a wound closed under tension) from "moderate cellulitis," although average examples in each group usually are clear enough. Wounds having both infection and a technical complication have been listed only once under the heading of infection. In each group of cases the wound was listed only under the most severe complication which it presented.

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TABLE III.—INCIDENCE OF INFECTION AND DELAYED HEALING (15 DAYS OR MORE) IN WOUNDS GROUPED BY FACTORS ACTING AT TIME OF SECONDARY CLOSURE OR LATER

Factor	Total wounds	Infection			Delayed healing		
		Number	Per cent	Significant difference	Number	Per cent	Significant difference
All wounds excluding 3 technical failures	197	57	29	—	41		—
Anesthetic							
Local	51	17	33	No	13	26	No
General	96	40	42	No	28	29	N
Number of wounds closed: 1 operation	92	26	28	No	16	17	N
Single wound	205	3	1	Yes	5	2	Yes
Two or more	11			—	0	0	—
Aerobic culture of wound: 1 operation	63	23	37	—	20	32	—
No pathogenic strains	75	23	31	Yes	8	11	N
One or more pathogenic strains	75	24	32	No	14	19	N
All cultured wounds	92	11	12	No	0	0	N
Operative procedure							
Wound excision	66	1	1	N			No
Simple closure	39		40	N	30		No
Wound revision	53		5	No	7	7	No
Topical sulfanilamide used	144	16	11	N	14	10	N
Not used	26	7	27	N	5	20	N
Wound tension at closure	172	30	17	N	26	15	N
Moderate or marked							
Not significant	7	4	57	Yes	16	23	Yes
Drainage of wound	180	23	13	Yes	1	1	—
Wound drained							
Wound not drained	44		1	—	3	7	—
Chemotherapy at time of closure	107	3	3	—			—
No chemotherapy	143	24	17	—			—
Oral sulfadiazine	10			—			—
Oral sulfadiazine & Penicillin				—			—
Penicillin only				—			—

*General anesthesia includes two spinal anesthetics.

The total healing time from secondary closure was determined for each wound. Here again there is latitude in interpretation but a wound was not regarded as healed until epithelialization was complete. In all but 2 or 3 instances the patient was kept under observation a sufficient length of time to determine the primary fate of the wound. In these exceptions the patients were transferred out 7 to 10 days after secondary closure, but healing seemed to be progressing normally at that time. In 5 cases it was possible to record the onset of late complication a week or more after apparent wound healing of the wound. It is necessary to point out, however, that in many cases the development of a late complication would not have come to our attention since the patient was promptly discharged to duty when thought fit and readmission would have been more than

likely at another hospital. This is an important but unavoidable limitation of the study.

ANALYSIS OF DATA

The following facts stimulated the present study. 44 wounds received no chemotherapy at the time of closure. Infection developed in 21 or 48 per cent. 107 wounds received oral sulfadiazine at the time of closure. Infection developed in 23 or 22 per cent. The difference is statistically significant (1). Rather than being a final conclusion this fact can only be the starting point of a detailed investigation since in a series of small it might well be a result of an artificial selection of wounds, or the unsuspected operation of other factors. For example the 107 wounds in which sulfadiazine was employed might have been the smallest, soonest treated and cleanest wounds of

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TABLE IV—COMPARISON OF INCIDENCE OF INFECTION AND DELAYED HEALING (15 DAYS OR MORE) IN U.S. SOLDIERS AND GERMAN PRISONERS

Effect of chemotherapy in wounds treated by excision and closure after delay of 15 days or more from original debridement.

	U. S. soldiers				German prisoners			
	To-tal	In-fec-tion	Per-cent	Per-cent	To-tal	In-fec-tion	Per-cent	Per-cent
All wounds	40	8	20	4	18	4	22	30
No chemotherapy	19	4	21	16	11	3	27	30
Oral sulfadiazine	19	4	21	20	8	1	12	4
Oral sulfadiazine & Penicillin	20	4	20	14	7	1	14	12

the entire series, and could be expected to heal well with or without sulfadiazine. In asaying the true effect of chemotherapy therefore it is necessary to account for the operation of the variables affecting wound healing and the development of infection.

Two standards of comparing groups of wounds have been utilized, in an effort to compensate for ambiguities or errors inherent in either system.

Incidence of infection. To determine the incidence of infection, each wound listed in Table I as having an infectious complication, no matter how trivial, has been tabulated. (Certain of these infections have been designated as serious, either on the basis of constitutional symptoms which they produced, their extent, or their persistence. They are briefly considered as a separate group in Table X.)

Incidence of retarded healing. Any wound not solidly healed in 14 days or less has been regarded as delayed in healing. A number of wounds with trivial infections (such as stitch abscesses) were well healed within 14 days. On the other hand, certain wounds without obvious infection were retarded (as in an unhealed drain site, or an undetected small separation of the suture line). The advantage of using this criterion as well lies in the fact that in some of these wounds been unrecognized low grade infection further more the best overall guide to therapy in these wounds is the healing time.

In an effort to circumvent the difficulties introduced by the use of both sulfadiazine and penicillin in certain wounds, the following division of the 200 wounds has been made: group A—no chemotherapy 44 wounds; group B—oral sulfadiazine only at time of secondary closure, 107

TABLE V—EFFECT OF LOCATION OF WOUND UPON INCIDENCE OF INFECTION AND DELAYED HEALING (15 DAYS OR MORE)

Location	All wounds				All wounds except in German prisoners			
	To-tal	In-fec-tion	Per-cent	Per-cent	To-tal	In-fec-tion	Per-cent	Per-cent
Neck and thigh	13	2	15	9	15	3	20	15
Elbow and lower leg	23	5	22	9	20	4	20	8
Back, chest, abdomen, thigh	29	14	48	5	20	7	35	15
Shoulder and upper arm	29	3	10	11	9	1	11	10
Forearm and wrist	14	3	21	3	10	1	10	7
Foot, ankle, perineum	14	3	21	4	12	3	25	25
Total	200	37	19	44	106	24	23	44

wounds; group C—oral sulfadiazine and intramuscular penicillin at time of secondary closure; group D—oral sulfadiazine with or without intramuscular penicillin at time of secondary closure (group B plus group C) 143

The 44 wounds in group A are the control group. They are compared throughout with the 107 wounds in group B and also the 143 wounds of group D. Some of the most difficult wounds of the series are to be found in group C, which explains why both agents were given as prophylaxis. This is reflected in the fact that there were 11 infections and 11 instances of delayed healing in these 36 wounds—a much higher incidence than is found in group B. It is therefore unfair to utilize group C as an independent group, but it is also impossible to exclude it from consideration. By running a dual comparison between groups A and B and D it is possible in group D to account for all infections which developed despite sulfadiazine, in group B on the other hand (which is roughly comparable to group A), absence of infection can be credited to the sulfadiazine alone. In group D the absence of infection would be with perfect justification partly attributable to penicillin. In practical application group A is to be compared with whichever shows the higher incidence of infection or delayed healing—groups B or D.

The 10 wounds in which penicillin was the sole prophylactic agent developed 4 infections, and 4 wounds had retarded healing—this group of wounds is used only in analyses of the series as a whole. Three wounds failed promptly and with out evidence of infection from purely technical

TABLE VI.—INCIDENCE OF INFECTION AND DELAYED HEALING (15 DAYS OR MORE) IN WOUNDS GROUPED BY FACTORS ACTING PRIOR TO SECONDARY CLOSURE—GERMAN PRISONERS EXCLUDED

Factor	Total wounds	Infection			Delayed healing		
		Number	Per cent	Significant difference	Number	Per cent	Significant difference
All wounds	199	24	12	No	28	14	No
Cause of wound	36	9	25		6	17	
Bullet		5	1		22	18	
High explosive		—	—	No	—	—	No
Other	30	9	30		8	27	
Type of wound	190	5	26		20	10	No
Perforating wound		—	—	No	15	7	
All others	21	1	5		13	6	
Size of wound	78	12	15	No	21	27	No
Large*		—	—		7	17	
Small	78	12	15		14	18	
Time of debridement from injury	40	6	15	No	7	17	No
24 hrs. or less		—	—		7	17	
25 hrs. or more	40	6	15		7	17	
Chemotherapy at time of injury	63	12	19	No	14	22	No
None or questionable		—	—		14	22	
Sulfadiazine ± Penicillin	91	7	8		14	15	
Delay—debridement to closure	68	17	25	No	21	31	No
10 days or less		—	—		21	31	
11 days or more	68	17	25		21	31	
Preparation of wound at general hospital	15	4	27	No	7	47	No
7 days or less		—	—		7	47	
8 days or more	15	4	27		7	47	

*Large wounds: those 9 cm. or more in length, or 3 cm. or more in width.

cases 2 from extreme tension and 1 from unobliterated dead space (not a hematoma) these three wounds have been also excluded from comparisons, since the failure was inevitable irrespective of a chemotherapeutic agent.

Tables II and III represent an analysis of the series as a whole from the standpoint of those factors thought most likely to affect the incidence of infection and delayed wound healing. The basic data are not very satisfactory in the category listed as chemotherapy at time of injury. The data were taken from the individual field records. No account is taken of the duration of the therapy or of the dosages employed. In some instances perhaps only a single dose was administered. It is possible that some patients did not receive the chemotherapy that the record stated they were given. It is probable that others were given some prophylaxis (since it was Army routine) in spite of the fact that it was not mentioned on the record. In busy forward hospitals, where the highest priority is given to the care of the seriously injured, errors in recording data

that have no great bearing on management of the lightly wounded are readily understandable. (Dates of injury and operation by way of confirmation, are very reliable.) Although there is an apparent increase in the incidence of infection in those who received no chemotherapy at the time of injury and although it is of great importance to determine its value further analysis in this paper is not warranted. It is of passing interest, however that what data there are in keeping with the conclusions of this study (This holds true for German prisoners as well as majority of whom received chemotherapy when injured.) Factors presenting significant increases in the incidence of both infection and delayed healing are the following: wounds in German prisoners yielding pathogenic bacteria when cultured at the time of closure and finally wounds in patients who did not receive oral sulfadiazine at the time of closure. Perforating wounds, delay in closure of the wound or delay in preparing it for closure, closure of the wound by block excision (usually related to delay) and failure to receive

TABLE VII.—INCIDENCE OF INFECTION AND DELAYED HEALING (15 DAYS OR MORE) IN WOUNDS GROUPED BY FACTORS ACTING AT TIME OF SECONDARY CLOSURE OR LATER—GERMAN PRISONERS EXCLUDED

Factor	Total cases	Infection			Delayed healing		
		Number	Per cent	Significant difference	Number	Per cent	Significant difference
All wounds	29	24		—	18	18	—
Anesthetic				N			No
Local	44	3	20		9	20	
General*	9	21	13		19	17	
Number of wounds closed at operation				No			No
Single wound	75	6			10	1	
Two or more	24	18			18	21	
Aerobic culture of wound at operation				Yes			Yes
No pathogenic strains	6						
One or more pathogenic strains	90	10	23		7	24	
All cultured wounds	37	20	27	—	7	9	—
Operative procedure				N			No
Wound excision	29	14	24		8	24	
Wound revision	15	10	29		7	20	
Simple closure	65	20	8		3	20	
Topical sulfadiazine used				No			No
Not used	2	3	3		4	3	
Wound treated with clostridia or marked				No			No
Not significant	120	29	21		24	18	
Drainage of wound				N			No
Wound drained	3		8		4	27	
Wound not drained	126	23	3		24	18	
Chemotherapy at time of closure				Yes			No
No chemotherapy	21	4	64			27	
Oral sulfadiazine	8	8			8	8	
Oral sulfadiazine + Penicillin	7	8	5		18	24	
Penicillin only			20	—		20	—

*General anesthesia includes two spinal anesthetics.

chemotherapy at the time of the original injury all show significantly increased incidence of infection but not of delayed healing.

The apparent susceptibility of German prisoners to infection demands further investigation. Cross analyses of the principal factors affecting infection in this series with respect to each other (not shown in the paper) demonstrates that in each separate category there still exists a significantly increased incidence of infection in the group of German prisoners as compared with United States soldiers. The most natural assumption to make in connection with poor results in German prisoners, namely, that it is largely due to delay between time of debridement and closure (with resulting block excision of the wound) is refuted by Table IV which specifically

compares the prisoners with United States soldiers on these two counts combined. Whatever the reason for the increase, whether debilitation, faulty nutrition or some other unsuspected cause, it is desirable to exclude German prisoners from further analyses of the effect of prophylactic chemotherapy.

Table V is an analysis of infection and delay cross analyzed by the location of the wounds. When corrected by excluding German prisoners, it can be seen that location is not a factor of much significance in this series.

Tables VI and VII repeat the analyses of Tables II and III excluding German prisoners. Partly because there are fewer cases (and the percentage differences must be correspondingly greater to register as significant) and partly be-

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TABLE VIII—EFFECT OF ORAL SULFADIAZINE ADMINISTERED AT TIME OF SECONDARY CLOSURE CROSS-ANALYSIS BY FACTORS WHICH TEND TO FAVOR INFECTION AND DELAYED HEALING—GERMAN PRISONERS EXCLUDED

Factor	Incidence of infection			Sulfadiazine treated			Sulfadiazine ± Penicillin		
	K chemotherapy			Sulfadiazine only					
	Cases	Infection	Percent	Cases	Infection	Percent	Cases	Infection	Percent
All wounds	31	14	44	34	8		107	5	17
Perforating wounds	8	6	75	14		1	18		
Large wounds	14	10	7	34	4	1	60	10	7
No chemotherapy at time of injury	7	7	100	1		100	14		14
5 days or more delay from debridement to closure	5	6	10	30	4	13	48		
5 days or more preparation of wound in general hospital	11	4	36	14	3	2	7	5	20
Local anesthesia at time of closure	13	7	50				38	6	5
Procedure	10	4	5	4	3	7	16	5	10
Wound excision	7	5	71	13			13	4	8
Wound revision	9	5	56	45	3	7	10		
Simple closure				8		6	97	7	5
Topical sulfanilamide used	10	3	30	61	7		68		6
Not used	5	6	12	53					
Two or more wounds closed at operation	5	6	12	53					
Wounds 6 cm. or more in length, or 3 cm. or more in width									

cause most of the differences are actually less, the only factors which continue to show significant increases in the incidence of infection are the presence of pathogenic organisms in the wound at time of closure and the lack of prophylactic oral sulfadiazine at the time of closure. However expected trends in other factors are still discernible although not so marked. It becomes worthwhile at this point to cross analyze these influential factors separately from the standpoint of prophylactic chemotherapy at the time of closure.

In Tables VIII and IX the incidence of infection and delayed healing is considered from the standpoint of those factors appearing to favor their development as related to the use of oral sulfadiazine. Significant differences are not indicated on these tables, because the breakdown produces wound groups with relatively few wounds. It is intended to show a trend however demonstrating a lower incidence of infection and retarded healing in the sulfadiazine-treated cases in almost every category. The only groups of wounds which fail to support this trend are those wounds requiring prolonged preparation and those wounds treated either by excision or revision and closure (This is also demonstrable

in Table IV) What there is about these wounds that should cause them to fall outside the general trend is not clear. Further analyses are not enlightening, and it must simply be recorded as a fact.

Table X considers the problem of the serious infection. In none of these patients did infection threaten life but in 18 wounds the infection was definitely more than trivial. There is again seen a sharp increase in the incidence of serious infection in German prisoners and again an increased incidence in those wounds not treated with prophylactic sulfadiazine. There are insufficient cases to render the difference significant in either prisoners or United States soldiers considered separately although when they are combined there is a significant advantage for the group which received sulfadiazine.

Table XI is a breakdown of the 73 consecutive wounds which were aerobically cultured at the time of secondary closure. It is unfortunate that all the wounds in the series were not cultured since the cultured group is not quite representative of the series as a whole (there is a higher incidence of infection than in the entire series). The common pyogenic organisms are considered

TABLE IX.—EFFECT OF ORAL SULFADIAZINE ADMINISTERED AT TIME OF SECONDARY CLOSURE, CROSS-ANALYSIS BY FACTORS WHICH TEND TO FAVOR INFECTION AND DELAYED HEALING—GERMAN PRISONERS EXCLUDED

Incidence of delayed healing (15 days or more)

Factor	No chemotherapy			Sulfadiazine treated					
				Sulfadiazine only			Sulfadiazine & Penicillin		
	Cases	Delay	Per cent	Cases	Delay	Per cent	Cases	Delay	Per cent
All wounds	21	10	48	21	3	6	107	16	15
Purifying wounds	8	6	75	14	1	7	3		
Large wounds*	4	6	15	24		6	60	8	13
No chemotherapy at time of injury		6	30	20			14		7
1 day or more delay from definite onset to closure	1	1	100	20	3	15	43	6	7
8 days or more preparation of wound in general hospital		3	67	6		13	17	3	18
Local anesthesia at time of closure	1	6	100	14	1	7	10		6
Procedure									
Wound excision	16		13	21		4	20	3	15
Wound revision	7		4	3			16	6	3
Simple closure	9	7	78	43		9	53	3	6
Topical sulfadiazine used	10		30	13		6	30		3
Not used	11	6	55	64		6	97	3	3
Two or more wounds closed at operation	8	3	38	43	3	7	63	1	16
Delay in infected wounds	14	6	43	6			16	7	44

*Wounds 6 cm. or more in length, or 3 cm. or more in width.

and again the analysis is subdivided according to the nationality of the patient. The numbers are so small that percentages have not been used, but the over-all trend slightly favors the wounds in which prophylactic sulfadiazine was employed. Once more this is less convincing in the group of German prisoners apparently being a German prisoner had a more decisive effect upon the healing of the wound than any other factor concerned.

Since as many as 5 wounds were closed at one sitting upon a single patient, and since the chemotherapy employed on the patient affected all 5 wounds equally, the objection might well be raised that it is unfair to treat the wounds statistically as separate from the patient. For example, 15 wounds on 3 patients not receiving sulfadiazine might all become infected and they might all have been the result of three breaks in operating room

TABLE X.—EFFECT OF ORAL SULFADIAZINE ADMINISTERED AT TIME OF SECONDARY CLOSURE UPON INCIDENCE OF SERIOUS INFECTION

	All cases			U.S. soldiers			German prisoners		
	Cases	Serious infection	Per cent	Cases	Serious infection	Per cent	Cases	Serious infection	Per cent
All wounds	187*	18	10	146	10	7	23	3	
No chemotherapy	43	10	23	33	3	10	3		43
Oral sulfadiazine	107	8	8	6			13	3	
Oral sulfadiazine & Penicillin	143	6	6	17	1		16	3	

*No penicillin-treated cases excluded, no serious infection developed in any of these.

There is a significant increase in the incidence of serious infection in the "No chemotherapy" category for all cases, although not for the subgroup of prisoners and U.S. soldiers.

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TABLE XI.—INFECTION IN WOUNDS CROSS-ANALYZED WITH RESPECT TO AEROBIC CULTURE AT TIME OF SECONDARY CLOSURE AND PROPHYLACTIC ORAL SULFADIAZINE—73 CONSECUTIVE WOUNDS

	All wounds		No chemotherapy		Oral sulfadiazine		Oral sulfadiazine + Penicillin	
	Cases	Infection	Cases	Infection	Cases	Infection	Cases	Infection
All wounds	73	33	33	13	44	18	47	8
German prisoners	18	3		7	3	3	16	3
U.S. soldiers	55	30	33	6	19	3	6	8
No growth or no pathogens			6		3		3	
Staphylococcus aureus	5	5	9	6	14	7	13	9
Staphylococcus albus	31	5	9	6	7	3	7	3
Streptococcus hemolyticus	8	6	6	6				1
Other streptococci	5	7			9	6	8	6
Staphylococcus aureus and streptococcus hemolyticus	14	1	3	3	3		3	
U.S. soldier only							13	
Staphylococcus aureus	1	7	3	4	1			
Staphylococcus albus	17	4	5	3				
Streptococcus hemolyticus		2					3	1
Other streptococci	3	4	4	4				
Staphylococcus aureus		5	4				10	6
Staphylococcus albus	6				9	5	1	8
Streptococcus hemolyticus and all streptococci			4	3	1	8	1	1
German prisoner only	4	8	4	3	6	4	6	4
Staphylococcus aureus	15	11					1	1
Staphylococcus albus		7	5		9		3	3
Streptococcus hemolyticus		3	3		7	5	7	3
Other streptococci								
Staphylococcus aureus		8	6					
Staphylococcus albus and all streptococci								

technique. This would obviously upset the entire series in a way not shown in the previous tabulations. Table XII deals with the series as patients rather than wounds. (A discrepancy of 3 extra patients shown in this table is accounted for by the fact that in 3 cases wounds were closed at two sittings a week or more apart for the purposes of this analysis the patients were regarded as new patients at the second operation.) An infection developing in any of the patient's wounds causes that patient to be listed under "infection" similarly with delayed healing. The over-all advantage for the sulfadiazine-treated patients is once more demonstrated as a trend.

The bulk of the cases not treated with sulfadiazine were in the early part of the series. A final objection might be raised that improved results came about as a consequence of better treatment of the later wounds (when experience was greater) rather than from the use of the sulfadiazine. Of the first 75 wounds 30 received

no chemotherapy. Infection developed in 13 of the 30 and there was delayed wound healing in 11. Of the second 75 wounds, 12 received no chemotherapy and in these 12 there was infection in 8 and delayed wound healing in 5. In the last 50 wounds 2 received no chemotherapy with no infection and no delayed healing. Although the majority lie in the first 75 wounds a high incidence of infection also occurred in those wounds placed later in the series.

Numerous cross-analyses of the data have been made which are not included here. They have all followed the same general trend showing an advantage for wounds treated prophylactically with oral sulfadiazine. It is believed that all the contradictory evidence has been presented.

DISCUSSION

Attention has been drawn to weaknesses inherent in an analysis of this particular group of wounds from the standpoint of the effect of

TABLE XII.—INCIDENCE OF INFECTION AND DELAYED HEALING (15 DAYS OR MORE) IN PATIENTS EFFECT OF ORAL SULFADIAZINE ADMINISTERED AT TIME OF SECONDARY CLOSURE

	Incidence of infection								
	All patients			U.S. soldiers			German prisoners		
	Number	Infection	Per cent	Number	Infection	Per cent	Number	Infection	Per cent
All patients	14	44	31	105	25	25	20	15	67
No chemotherapy*	16	6	44	26		30	8	3	63
Oral sulfadiazine	73	26	37	53	8	15	20		60
Oral sulfadiazine + Penicillin	0	25	25	7	3	43	3		63

*The incidence is significantly higher in the "No chemotherapy" group in U.S. soldiers, but not in the other groups.

	Incidence of delayed healing								
	All patients			U.S. soldiers			German prisoners		
	Number	Delayed	Per cent	Number	Delayed	Per cent	Number	Delayed	Per cent
All patients	14	14	100	105	24	23	20	14	70
No chemotherapy	16	3	19	26	8	30	8	5	63
Oral sulfadiazine	73	14	19	53	6	11	20	8	40
Oral sulfadiazine + Penicillin	0	3	3	7	4	57	2	0	43

The differences are not significant statistically. Infection or delayed healing in any wound of several on the same patient, places the patient in the appropriate group, although all the other wounds might have healed perfectly. (See text for details.)

prophylactic sulfadiazine. They lie in the small size of the series, and in the fact that therapy was not originally planned as a research project. On the other hand, the series is personal, consecutive, and accurate observations on the fate of each wound are available—a set of circumstances not frequently met with where battle casualties are concerned.

A number of factors affecting wound healing and development of infection have been analyzed. German prisoners were shown to have a high incidence of infection and delayed healing in respect of other factors, and the bulk of the analysis has therefore excluded them. It has been shown that wounds which were excised and closed, or which had prolonged delay before closure did not appear to have a significant response to prophylactic chemotherapy the reasons for this are not clear. Wounds in nearly every other category appear to benefit by a course of oral sulfadiazine given prophylactically at the time of secondary closure. The general trend is rendered more significant by the fact that by and large the worst wounds received chemotherapy on empirical grounds in the interest of obtaining the best possible results. (Evidence for this statement is the high incidence of infection and delayed healing in the small group of wounds in which

both sulfadiazine and penicillin were employed prophylactically.)

Suggestive evidence that prophylactic chemotherapy at the time of the original injury—days or weeks before the patient reached a general hospital—decreases the incidence of infection after secondary closure was not pursued because of the likelihood of error in the recordings on the field record of the patients. A consideration of the value of topical sulfanilamide employed at the time of secondary closure is likewise beyond the scope of this paper.

It is recognized that the conclusion in this study is at variance with those of Meleney arrived at in an elaborate statistical study of a much larger series of cases. The two series are not strictly analogous, however. These are wounds produced by the missiles of war as opposed to wounds incurred through civilian trauma. These are wounds in which closure is delayed deliberately for days or weeks after injury as opposed to civilian wounds the vast majority of which can and should be closed as soon after the original injury as possible. Finally these are wounds in patients who have already received, for the most part, some type of prophylactic chemotherapy; perhaps this early chemotherapy inhibits the growth of certain bacteria which lie latent in the

wound until stirred up by operative closure when they will produce infection unless inhibited again by another course of chemotherapy. Perhaps this early chemotherapy renders the wound more susceptible to infection at later operation than it would have been had no prophylaxis been used at all and the wound permitted to develop unaided its own local tissue immunity.

CONCLUSION

A personal, consecutive series of 200 secondary closures of soft tissue war wounds is analyzed

from the standpoint of the prophylactic effect of sulfadiazine administered orally at the time of closure.

The evidence presented favors the view that sulfadiazine so employed is beneficial and that it reduces the incidence of postclosure infection and delayed healing.

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THE PELVIC AUTONOMIC NERVES IN THE MALE

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NUMEROUS descriptions of the pelvic plexus of nerves are to be found in the literature. Although some of them are excellent neurologically none provides serially arranged illustrations prepared from actual gross dissections. In the present article it will be the authors sole purpose to portray the structure of the pelvic plexus and associated nerves in atlas fashion, with description of related layers and organs.

LITERATURE

Anatomy According to Davis (1933 1934) the pelvic plexuses consist of interlacing groups of nerve fibers and of many but extremely small ganglia situated on either side of the ampulla of the rectum. The dimensions of each plexus are said to be 2 by 3 by 1 centimeter. The two plexuses are described as embracing the rectum in the manner in which the levator muscles embrace the anal canal. On each side the plexus is bifurcated, the medial sheet being a continuation of the hypogastric nerve, the lateral a prolongation of branches derived from the sacral nerves. The two hypogastric nerves are joined at a lower level in the pelvis by parasympathetic fibers of the second to fourth sacral segments, these fibers making up the nervus erigens. The two contributions, together with sympathetic fibers from the pelvic chain ganglia, form the pelvic plexus.

The central connections, according to Whitte (1935) are made up of preganglionic fibers from lower thoracic and upper lumbar levels of the intermediolateral columns of the spinal cord. Cells send out axons over the white rami of the lower thoracolumbar outflow to lumbar and pre-aortic ganglia. Postganglionic neurons originate in sympathetic trunks as well as in pre-aortic ganglia to form a plexus which descends with the abdominal aorta. At the level of the inferior mesenteric artery are situated two small ganglia which, supplying a circumarterial plexus for branches of the inferior mesenteric artery ultimately innervate the sigmoid colon and rectum. The remainder of the descending sympathetic fibers form the superior hypogastric plexus in the region of the bifurcation of the aorta. The plexus divides into two plexiform sets of nerves which

enter the pelvis, along its lateral wall as the hypogastric nerves (or plexuses).

Pelvic roots, forming the nervi erigentes, arise from medial aspects of the anterior primary divisions of the second to fourth sacral nerves, 1 to 1 centimeters from their foraminous exits. They course to the pelvic plexus, or directly to the rectum. Two or three fine twigs arise from each of the ganglia of the sacral sympathetic chain and enter the posterior border of the pelvic plexus.

The urinary bladder receives sympathetic fibers from the celiac, renal, and mesenteric ganglia, as well as from the first four lumbar ganglia of the sympathetic chain. These fibers, by way of the hypogastric plexuses, and in descent into the pelvis, receive fibers from the last lumbar ganglia, from the inferior mesenteric plexus, and from the superior hemorrhoidal nerve. They also receive fine filaments from the sacral sympathetic chain.

The parasympathetic fibers (from sacral roots) first gathered together as the nervi erigentes, separate into three groups the upper supplies the fundus of the bladder the middle supplies the midportion of the bladder and the lower courses to the inferior aspect, the vesical neck, and the adjacent portion of the urethra.

The cells of origin for these efferent fibers (parasympathetics) to pelvic organs lie in the intermediolateral column of the sacral region. The locations of cell bodies for the afferent fibers are as yet undetermined, but are probably in posterior root ganglia.

The prostate and seminal vesicles receive their innervation from the middle group of fibers while the rectum is innervated by the inferior group and by some fibers, which, remaining independent of the pelvic plexus, are sent directly from the hypogastric nerve and chain ganglia.

Physiology The sympathetics, according to Davis (1934) and Meigs (1940), behave as vasoconstrictors and as inhibitors of the musculature of sigmoid colon, rectum, and bladder. They cause ejaculation and contraction of the sphincter of the bladder. Pseudosensory properties are regarded as vasomotor in foundation. The fibers are also glandulomotor to both superficial and deep glands.

The parasympathetics produce vasodilatation and release of the various sphincters. They mediate pain sensation from the bladder. Section of

Contribution No. 444 from the Anatomical Laboratory of Northwestern University Medical School, Chicago, Illinois

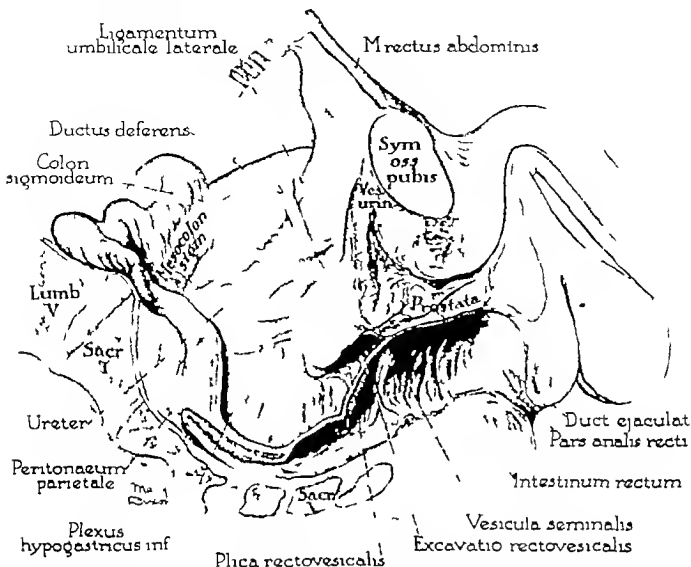


Fig. 1. Topography of the hypogastric plexus and related pelvic structures in a hemisectioned specimen peritoneal level (successively deeper levels of same specimen in Figs. 2 to 6). The left half of a male pelvis, peritoneum intact. The section passes through the entire length of the rectum

and through the urinary bladder, urethra, etc., and prostate (latter hypertrophied). The section also passes through the interpubic fibrocartilage, seminal vesicles, retropericolic plexus of veins, scrotum, and penile cavernous tissue.

the superior hypogastric plexus does not cause atrophy, or disturbance of any motor functions of the bladder. excision of parasympathetics would cause increased blood supply to the pelvis, a lessening of visceral muscle spasm and interruption of pain impulses to higher centers. Schroeder (1939) quotes McCrae and McDonald (1934) as doubting if either system (parasympathetic or sympathetic) is exclusively excitator or inhibitor these authors believe the two work together and with somatic nerves, to regulate bladder function. Yet they are of the opinion that the parasympathetics are more important and that they carry the stronger impulses.

Surgery. Jaboulay (1899) first directed attention to the fact that pain could be relieved by

surgery of pelvic sympathetics. Although Latarjet (1913) adequately described the pelvic sympathetics, the first presacral neurectomy was reported by Cotte (1925). Pieri (1926) tried Cotte's operation for relief of pain in tuberculous cystitis finding the surgery only partly successful. he next excised, with more satisfactory results, the lateral sacral chains at the level of the first sacral segment, and the communicating rami thereof. Learmonth (1930) employed Cotte's method in an attempt to correct neurogenic imbalance of the bladder. More extensive reports were made by Davis (1933, 1934) and Meigs (1940) on the relief of pelvic pain by presacral neurectomy. Schroeder (1939) enumerates several operative procedures for relief of bladder pain: excision of the superior

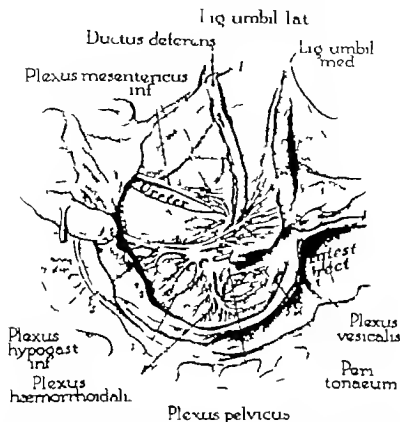


Fig. 2. Topography of the plexuses, ureter and ductus deferens immediately subperitoneal level. Showing the structures related to the pelvic colon and rectum, namely ureter, bladder, ligaments, and nerves. The parietal peritoneum of the lesser pelvis has been removed, and, additionally, the vesical part of the visceral peritoneum. The serous layer remains as the pelvic mesocolon, the covering of the colon and rectum, the rectovesical fascia and also as the bilaminar septum which descends between the bladder and rectum and rectum (fascia of Denonvilliers marked by arrow here and in Fig. 1). The ureter, ductus deferens, umbilical ligament (obliterated artery) and nerves have been freed from the thin stratum of subperitoneal areolar tissue.

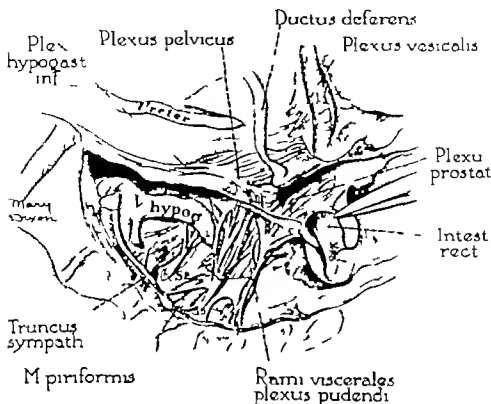


Fig. 3 Relation of the hypogastric plexus to the terminal vesical plexus, and to the deeper rami derived from the sacropudendal plexus. The latter are situated at parietal level. Depicting the rectum urinary bladder ductus deferens, ureter pelvic autonomic nerves, and related structures. The following have been removed: pelvic colon proximal part of rectum (distal segment retracted) superficial leaf of autonomic nerves to the point of severance of the rectum (opposite fifth sacral vertebra). The nerves are followed toward the rectovesical excavation; the ductus deferens is mobilized as far as its point of junction with the seminal vesicle where the associated nerves lie within the rectovesical fold. The hypogastric and gluteal veins are exposed. The sacral sympathetic chain with communicating fibers from the second to the fourth sacral, is exposed, as is also the subjacent piriformis muscle. The layers shown are in succession: hypogastric and pelvic plexuses lodged chiefly in subperitoneal areolar tissue; heavy retroperitoneal connective tissue, upon which the visceral branches of the above named plexuses rest or through which they pass; visceral rami of the sacropudendal plexus of nerves; musculature (piriformis, passing from the sacrum through the greater sciatic foramen).

nerves and related structures they were prepared at life size.¹ An accessory illustration (Fig. 7) reduces the nerves to a schema. The diagrammatic sections (Figs. 8 and 9) are based upon a coronally cut pelvis of a second male specimen. Between the prostate gland and the rectum it descends as a partially fused plate of tissue termed Denonvilliers' fascia (arrow Fig. 1).²

OBSERVATION AND DISCUSSION

Peritoneum. The peritoneum is elevated by the obliterated hypogastric (umbilical) artery, slightly by the superior vesical branches derived therefrom and by the ductus deferens and ureter (Fig. 1).

The rectovesical fold is prominently tall; it is little more than apposed layers of peritoneum projects 1 centimeter backward from the bladder the excavation which it guards is 1.5 centimeters deep, measured from the edge of the fold to the depths of the rectovesical excavation. The transverse vesical fold is but a slightly elevated part of the peritoneum. The lateral umbilical fold has a maximum height of 1.5 centimeters (at the pubic crest), the fold is flattened so that its space opens lateralward.

The pelvic colon possesses a mesocolon which is 6 centimeters long where the colon reaches the midline over the fourth lumbar vertebra (Fig. 1); the mesentery becomes gradually shorter, being 2 centimeters long in the true pelvis opposite the first sacral vertebra; fixation occurs at the level

¹Comparable strata in the female pelvis were illustrated in an earlier article (Figs. 1 to 4; Carth, Anson, Ashley and Jones, 94).

²The reader is referred to the excellent article on Denonvilliers' fascia by Tobin and Benjamin in an earlier volume of this journal.

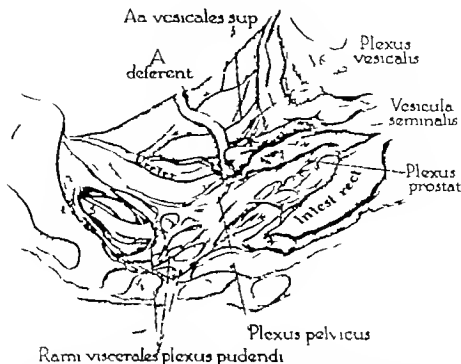


Fig. 4. Form and composition of the deeper leaf of plexus. Showing the pelvic plexus, the superficial leaf of which has been entirely removed to expose the deep layer of the plexus: a) tonomic plexus and the nerves contributing to its fabric. The nerves from the second to fourth sacral (erigens) remain intact, and the anterior continuation of the pelvic autonomic plexus has been followed ventralward to the bladder seminal vesical, and prostate. The rectum, transected at coccygeal level, has been retracted. The large vein which verlay the first sacral nerve (in Fig. 3) has been removed. The superficial group of vessels is exposed (superior and middle vesicular arteries from the obliterated hypogastric) the deep vessels (hypogastric and external iliac) remain covered by the heavy lamina of pelvic fascia. The main mass of the plexus is parietal in position, resting upon those which, in turn, lies immediately upon the obturator fascia.

of the ridge between the second and the third sacral segments. The pelvic colon is constricted through the greater part of its length. The rectum is similarly constricted as it lies in front of the third and fourth sacral pieces. It widens slightly in front of the fifth, and further enlarges as it passes distalward beyond the area of vertebral relationship. The narrowed anal canal leaves the rectum at an angle of almost 90 degrees. The three portions of the tube are then, related to one another as the parts of a letter Z reversed.

Subperitoneal structures The heavier retroperitoneal tissue which ascends on either side of the urinary bladder as a wing to iliac level, in projecting backward forms the plate of tissue over which the peritoneum is draped to produce the rectovesical fold (Fig. 2).

The observations on the general arrangement of subperitoneal tissue are in accord with those made earlier on the female (Curtis Anson, and

Benton 1940) Vessels in the category of the hemorrhoidal are lodged in a fine areolar layer which is immediately subperitoneal, autonomic nerves coursing to viscera are next in level, becoming more superficial as they approach the organs. Parietal vessels are placed in the heavy connective tissue which is clearly "parietal" and with them are situated visceral rami most deeply placed, and actually retrofascial, are the elements of the sacral and lumbar plexuses, from which latter communicating rami are sent through the heavier retroperitoneal tissue to reach the autonomic plexuses near the bladder and rectum.

The ductus deferens, ureter and accompanying nerves lie within a thin areolar layer with the middle hemorrhoidal and associated sympathetic plexus (which give off rectal, vesical, and prostatic sets of nerves). Still covered by tissue of areolar character but evident as elevations, are the "obliterated" hypogastric artery (lateral umbilical ligament) and its derived superior vesical

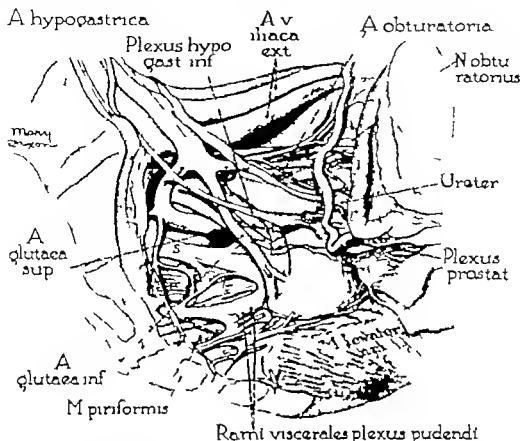


Fig 3 Parasympathetic origin of the rami contributory to the pelvic plexus, and deep structures related to the latter. The deep relations of the pelvic plexus, shown by removal of the plexus and the heavy retroperitoneal tissue which partially invests it. The transected parasympathetic nerves (visceral rami of the pudendal plexus) remain connected with the sacral plexus; the distal continuations of the autonomic nerves have been cut as they disappear beneath the prostate and seminal vesicle. The connections between the inferior hypogastric plexus and the pelvic plexus have been severed along the inferior margin of the former. All of the retroperitoneal connective tissue has been removed, exposing the endopelvic fascia, the vessels and nerves to the pelvic viscera and parietes, and to the lower extremity. The connective tissue has been removed from the greater sciatic foramen to expose the full course of the nerves contributory to the sacral and pudendal plexuses and the larger vessels as they leave the pelvis. The superior fascia of the pelvic diaphragm has been removed, exposing the levator ani muscle.

branches. The outlines of the gluteal obturator middle hemorrhoidal and pudendal vessels are masked by the heavy retroperitoneal layer.

Nerves. Most important is the position of the several sympathetic plexuses (Fig 2 cf Fig 7). They are parietal in position; they do not immediately surround the organs as familiar textbook illustrations would lead one to believe. Actually the large middle hemorrhoidal is actually 5.5 centimeters distant from the rectum; it sends numerous rami to the rectum, these passing posteriorly over an area bounded by the line at pelvic mesocolic attachment (above) and the line projected (below) from the superior surface of the urinary bladder. In the erect body their direction would be horizontal, while that of the trunk from which they are derived would be vertical.

The deeper structures are chiefly related to the nerves of the intermediate and deep leaves (Fig 3). The intermediate leaf consists of the parasympathetic fibers of the second third and fourth sacral and sympathetics which enter these just lateral to the chain ganglia. The parasympathetics (nervus ergens) intercommunicate forming a small plexus which makes up a deep leaf. The two layers meet approximately 3 centimeters lateral to the rectum. Some of the fibers of the parasympathetic derived from the fourth sacral diverge medially to enter the wall of the rectum. The intermediate leaf is separated from the deep (sacral plexus) by the large hypogastric vein and its gluteal tributary. The vein in turn crosses the piriformis muscle obliquely. From the large ganglion resting upon the lateral surface of the body

urethra to innervate those structures. There is a separate group of small fibers which passes into the region of the seminal vesicle. Some fibers detach themselves from the plexus to supply the terminal portion of the rectum.

The superiorly located fibers of the plexus pass beneath the seminal vesicle and the crooked portion of the ductus deferens to enter the wall of the bladder. The lowermost, as previously mentioned, enter the rectum, and intermediate fibers continue to the prostate and membranous urethra.

The distance from the mid point of the plexus to the lateral rectal wall is 3.5 centimeters. The length of the Y-shaped plexus is 8 centimeters (to the nerves at the prostate).

The parasympathetic nerves are five in number (Fig. 5) severed at the point of entrance into the plexus. The cranial two arise from the junction of the second and third sacral, the third arises from the third sacral, the fourth nerve from the fourth sacral entirely, and the fifth from the junction of the third and fourth. The plexus is prolonged between the rectum and prostate; the plexus was previously described as an intermediate group of nerves leaving the plexus and entering the prostate, the inferior aspect of the bladder and the seminal vesicles. The inferior or caudal group of nerves leaves the plexus to enter the ampulla of the rectum as three or four stems of gross dimensions.

Vessels. The hypogastric artery and its branches and corresponding veins lie deep to the fascial layers which house the autonomic nerves (Fig. 5). The most superiorly placed vessels are the external iliac artery and vein. Next is the umbilical artery with its four vesical branches, all of which course first toward the superior surface of the bladder, some then passing to the inferior. The vesical arteries are lodged in an intermediate layer of connective tissue which covers the deep vessels and remains entirely separate from them. The small deferential artery takes origin from the lowermost of the vesical arteries, the ureteric artery also in this layer arises from the small vesicular branch just above the one which gives origin to the deferential. Another small artery passes directly through the plexus to enter the tip of the seminal vesicle. The obturator arises by a common stem with the umbilical, the gluteals descending leave the pelvis above and below the piriformis muscle. The inferior gluteal artery gives rise to the internal pudendal just before it leaves the pelvis.

The vessels are internal to the endopelvic fascia (Figs. 5 and 6).

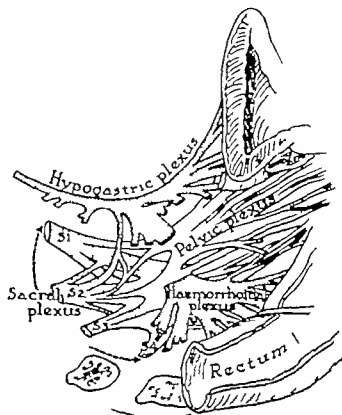


Fig. 7. Diagram of the pelvic plexus, showing origin and distribution of the chief components, and their gross interrelationships. Medial aspect. The hypogastric plexus is shown intact in its curving course to the urinary bladder but has been cut away in that part which, overlying the pelvic plexus, contributes to the hemorrhoidal plexus. Between these two, and lateral to them, the fibers derived from the sacral nerves are shown streaming toward the bladder, prostate, anal canal, rectum, etc.

The endopelvic fascia. The so-called endopelvic fascia is actually aponeurotic in nature. Continued upon the levator ani and coccygeus muscles the endopelvic fascia becomes diaphragmatic fascia (Fig. 6). Over the upper part of the obturator internus muscle it is parietal and when reflected from the pelvic diaphragm to the rectum and bladder it becomes visceral (cf. figures in Curtis Anson and Beaton, 1940).

It is clear, then that the relations to fascial levels are of fundamental importance. In the heavy retroperitoneal layer is located the large pelvic plexus, with its vesical and prostatic continuations (Fig. 4). Into this layer sink the originally superficial fibers of the inferior hypogastric plexus (Fig. 2) and to it ascend the visceral rami originating from the sacral plexus of nerves (Figs. 3 to 5). In dissections this set of relationships is strikingly demonstrated when the heavy stratum is reflected (Fig. 3) as they enter the pelvis from above the sympathetic fibers are situated just beneath the serous layers and upon the heavy

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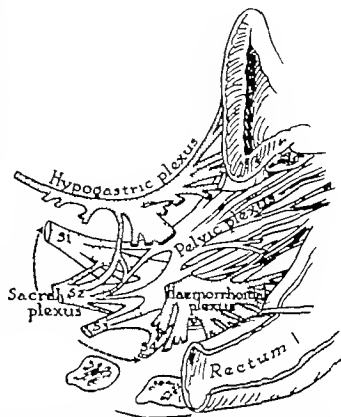


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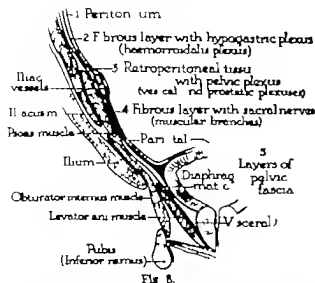


Fig. 8.

Figs. 8 and 9. Diagrams of the location of autonomic nerves, showing relations of the main sets to the subserous strata of the pelvis. Coronal sections in anterior view. The chief elements of the broad pelvic plexus are lodged in the heavy layer of retroperitoneal tissue (at level 3) the hypogastric plexus and its subdivisions are situated in thinner layer internal or medial thereto (level 2) while the sacral plexus and its fibers to pelvic musculature are located

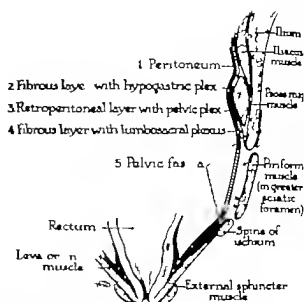


Fig. 9.

located external or lateral to retroperitoneal layer (at level 4). Posteriorly to the greater sciatic foramen its nerves (at site of crosses in Figure 9) contributing chiefly to the formation of the sciatic nerve rest upon the fascial covering of the piriformis muscle.

retroperitoneal layer on the contrary the para-sympathetics, originating behind, are located beneath the heavy layer and upon the endopelvic fascia as the latter covers the parietal musculature (obturator internus). All of the fibers from these two sources which ultimately reach the urogenital organs enter and course through the heavy retroperitoneal layer this would be the expected arrangement, since the strong fibrous layer becomes the immediate coat of each of the pelvic organs, merging with the sheath derived from the endopelvic fascia.

Sciatic foramen. The sciatic foramen is bounded anteriorly by the arching border of the endopelvic fascia. Through it passes the superior gluteal, inferior gluteal, and internal pudendal arteries, and the lumbosacral nerves which converge to form the sciatic. The parasympathetic nerves (nervus erigens) also visible, arise just before the sacral trunks join. The most caudal of the nerves arising from the sacral plexus is the nerve to the levator ani.

Ischiorectal fossa. The visceral ramal derived from the sacropudendal plexus are, then, prominent as a group where they leave the sacral nerves at the archiform border of the sciatic foramen (Figs. 5 and 6). But, within the ischiorectal fossa, comparable fibers to the erectile bodies are difficult to segregate they tend to follow inconspicuously the pudendal nerve.

The ischial spine constitutes the serviceable landmark around it the obturator internus disappears as it leaves the pelvis attaching to the ischial spine are the posterior end of the iliopectineus part of the levator ani, and the lateral insertion of the coccygeus muscle which forms the posterior fourth of the pelvic diaphragm.

CONCLUSIONS

The autonomic nerves of the pelvis make up a set of neural sheets which not only are of gross dimensions, but which are of such position and form as to be demonstrable in the form of subperitoneal bands with predictable relationships to bony landmarks, to large blood vessels and to viscera. The large bands and the lesser contributory fibers as they course from root or plexus of origin to area of visceral termination, are either lodged within readily dissectable fibrous laminae or situated at levels either immediately superficial or deep to such laminae.

The chief layer is that which is most marked as it extends upward along the pelvic wall after having formed a strong sheath for the urinary bladder and associated structures. It is the layer which transmits, also, the blood vessels of visceral supply. Resting upon this stratum, at subperitoneal level, is an areolar tissue in which is situated most of the nerves of supply to the rectum under the same stratum are placed the sacropudendal plexus

and the rami which pass therefrom to the large plexus in the intermediate layer. The intermediate is therefore, the chief one of the three into the pelvic plexus which it contains pass rami from the sympathetic and parasympathetic plexuses in layers on its internal and external aspects.

In the superficial (internal) layer of areolar tissue course the hypogastric plexus that portion of the pelvic plexus which sends rami chiefly to the rectum, the contributory mesenteric plexus, and the ductus deferens. These are structures which are subperitoneal or were originally mesenteric (when, embryonically a mesorectum existed). Being placed immediately beneath the serous lining of the pelvic cavity they elevate the peritoneum—but less markedly than do the umbilical ligaments (Fig. 1).

Topographically, the inferior mesenteric plexus lies anterior to the ureter following it closely the inferior hypogastric plexus and its pelvic prolongation lie posterior to the ureter between the latter and the rectum. The main mass of the plexus courses in a curving line—concave anteriorly—between the first piece of the sacrum and the rectovesical fold.

In its distal portion the fibers spread out principally on the superior surface of the bladder behind, groups of fibers radiate to the rectum a strong set forming a secondary plexus close to the rectal wall. Altogether these plexuses and derived fibers of visceral supply cover a semicircular area whose posterior boundary follows the contour of the rectum and that of the sacrum against which the latter rests (Fig. 2).

Embedded in the heavy layer of true retroperitoneal tissue are the deeper elements of the autonomic supply (Fig. 4). The anterior boundary of this set of fibers coincides with that of the more superficially situated hypogastric plexus, but its form is strikingly different. It assumes the configuration of a broad ribbon wider at the proximal and distal ends than in the middle two-fourths of its extent. Its widest portion is proximally situated, where visceral rami are contributed by the sacral nerves (Figs. 3 and 4) upon it converge, distally the fibers of the vesical portion of the pelvic plexus, to produce a second broadening terminal distribution to the bladder prostate, seminal vesicles and rectal ampulla is also instrumental in causing the widening of the band which occurs at its anteroinferior end. In an anteroposterior direction this intermediate band is somewhat more extensive than the superficial the former is carried to the sacrum (the points of origin of the nerves Fig. 4) the latter to the rectum (the visceral area of supply Fig. 2). The

intermediate band is the longer of the two owing to the fact that the greater bulk of its fibers are supplied, not to the rectum in the sacral curve, but to the bladder prostate, anal canal, as these rest upon the pelvic floor.

The third and deepest of the three neural strata is that composed of the proximal portions of the visceral rami of the pudendal plexus and the sacral plexus, from which the rami are derived. Because the branches quickly enter the pelvic plexus—merging on the latter's deep aspect, and within the substance of the heavy retroperitoneal tissue—this third layer is but slightly longer than it is wide. It overlies the second to fourth nerves (from which it arises) being thus caudally placed, its long axis is at almost a right angle to that of hypogastric plexus in the superficial, or first layer. The upper cords of the sacral plexus, and the lumbosacral cord from the abdominal level rest in similar tissue upon the piriformis muscle the pudendal rami leave the nerve trunks near the point where the latter emerge through the greater foramen en route to the gluteal region. As the rami course toward the pelvic plexus, they come to lie upon the fascia covering the obturator internus.

The sympathetic fibers which descend into the pelvis from abdominal level form the mesenteric and hypogastric plexuses the parasympathetic fibers, commonly described as forming a nervus ergens, enter the pelvic plexus as a set of autonomic nerves. All fibers, so far as gross examination reveals are mixed in the broad ribbon of nervous tissue which is termed pelvic plexus. Therefrom fibers stream toward the several pelvic organs, a degree of stratification obtaining in the distribution to mesenteric and to retroperitoneal viscera for the most part nerves to the rectum pass, on immediately subperitoneal or superficial, level, from the anterior border of the plexus backward in radiating fashion to the pelvic portion of the digestive tube similarly nerves to the urinary bladder subjacent prostate gland to the seminal vesicles, lodged, at the intermediate level in the heavy sheath of retroperitoneal tissue stream downward and forward to the organs named—all ultimately supported by the funnel-shaped pelvic diaphragm.

From the surgical standpoint the following conclusions seem warranted sympathetic fibers may be transected by presacral neurectomy parasympathetic elements left untouched by the same procedure in both abdominal and perineal approach to the rectum (in high operation for carcinoma) the chief portions of the autonomic plexuses are removed by safe distance, from the

surgical field—being parietal in position in the dorsal portion of the pelvic cavity in any of the regular approaches (pubic, transsymphyseal perineal or rectal) to the urinary bladder or prostate gland the disturbance of tissue would occur in areas where concentration of autonomic fibers is minimal—behind the main plexiform aggregations in anterior approach, and above them in inferior entrance to the pelvis. However in wide removal of carcinomatous lymphatic and associated fibrous tissue within the pelvis, the areas where nerves are abundant would be affected the plexuses, in resting upon the hypogastric artery and its important branches, are situated between the peritoneum and the lymphatics, since the latter are closely associated with the blood vessels.

In summary, then, it may be said that the nerves of supply to the pelvic organs are so disposed as to be naturally protected from damage in urological surgery. In spreading out upon the bladder from behind and above, terminal fibers are fewest on the anterior (apical) and inferolateral portions in supplying the rectal and anal parts of the canal the nerves do not descend with the tube in the form of an investing net, but, approaching the canal from the side they end in relation to local

segments. Finally it may be pointed out that so great is the intermingling within the plexus of fibers derived from various sources that localized excision or extirpation would be expected to result in relatively slight interference with function of a pelvic organ.

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STUDIES ON EXOPHTHALMOS PRODUCED BY THYROTROPIC HORMONE

II Changes Induced in Various Tissues and Organs (Including the Orbit) by Thyrotropic Hormone and Their Relationship to Exophthalmos

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IN a preceding publication (21) the development of exophthalmos in thyroidectomized animals receiving various preparations of thyrotropic hormone was described. Antuitrin T produced a striking degree of exophthalmos but in many animals it also produced profound myasthenia and loss of weight in spite of the absence of the thyroid. A so called purified preparation however failed to produce exophthalmos, toxic manifestations or loss of weight but did cause some hyperplasia of the thyroid of intact animals. A crude thyrotropic preparation which was prepared in a manner similar to that of the so called purified preparation but without the additional efforts at purification and which was administered in quantities equal in thyroid stimulating effect to the purified product caused exophthalmos. This exophthalmos, however, was less striking than that produced by antuitrin T. Toxic effects and loss of weight from the crude preparation were minimal. The specific metabolic principle, a fraction of thyrotropic hormone did not produce exophthalmos and was known from the work of others (8, 18, 19) not to produce thyroid hyperplasia.

The tissues of these animals, from which accurate data on exophthalmos have been obtained have furnished the source of material for this report.

LITERATURE

In 1936 Smelser (43) described an infiltration of a stainable material accompanied by nests of lymphocytes and edema in the extraocular muscles and orbital fat of guinea pigs rendered exophthalmic by thyrotropic hormone. This was confirmed by Paulson (37, 39) who also described loss of striations in the extraocular muscles. Smelser (44, 46) concluded in later papers that the changes in muscle were confined to the connective

tissue between the muscle fibers. Paulson (38, 39) later found muscle degeneration and round cell infiltration in cardiac and other skeletal muscles. He reported that this change was most striking in the first few days of administration of thyrotropic hormone and that it occurred regardless of the presence or absence of the thyroid. The cellular reaction was found to be much milder degree in normal and thyroidectomized control animals.

Aird (12) demonstrated varying degrees of cellular reaction in extraocular muscles and edema of orbital tissue with several thyrotropic preparations. Brock (13) although primarily interested in cellular infiltration in cervical sympathetic ganglia mentioned the feature in muscle. Smelser (44) and Paulson (37) reported that the muscle changes might not be present although exophthalmos developed. Paulson (38) could not demonstrate an appreciable increase of the water content of muscles but in agreement with Smelser (44, 47) he did show an increase of the water content and volume of the orbital tissue masses.

Smelser (45) after finding an edematous infiltration in the connective tissue of fat in the orbit studied other fat depots. Cervical and axillary fat were unaffected but the fat about the kidneys, ovaries and ureters appeared to be involved by the same process although to a much less striking degree than in the orbit. These observations on fat depots other than the orbit have not been confirmed. Since the investigation described in this publication was carried out Smelser (47) has described an increase of the residue of the orbital tissues after the extraction of fats and water in animals that have been given thyrotropic hormone.

The significance of the cellular reaction elicited by thyrotropic hormone in fat, connective tissue and muscle is not understood. Just what the relationship of these tissue changes may be to the exophthalmos that develops is not certain. A cellular reaction accompanied by edema and fibrosis in orbital tissues of patients suffering from

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Dr. Dobyns, 1 Now in Surgery M. J. Foundation.



Fig. 1. Left, perinephric fat from normal control guinea pig. Right, perinephric fat from guinea pig treated with antuitrin T. Note the apparent replacement of opaque fat by a more transparent gelatinous material (transillumination X).

malignant exophthalmos has been described by Naffziger and many others (11, 12, 13, 17, 22, 23, 27, 31, 32, 33, 36, 43, 44, 48). It may be of interest that Haik (27) recently reported "extreme fatty metamorphosis of the liver" and cloudy swelling in the kidney in a case of malignant exophthalmos at necropsy. Naffziger (34) reporting on muscle biopsies from locations other than the orbit, did not observe the muscle changes usually encountered in the orbit.

EXPERIMENTS PRELIMINARY TO THIS STUDY

In preliminary experiments, examination of tissues of animals receiving antuitrin T confirmed these reports of the presence of round cells in orbital tissue, to a lesser degree in muscles, and in many of the fat depots throughout the body. In other preliminary studies it was found that these cells contained many fine droplets of fat. Likewise muscle fibers throughout the body and the cells of the liver and the kidneys were loaded with fat droplets after thyrotropic hormone had been administered.

PURPOSE OF THIS STUDY

The purpose of this study was to investigate the possibility of a general systemic cellular reaction in guinea pigs given antuitrin T and to correlate these reactions with those known to occur in the orbit associated with exophthalmos. In addition observations were made of the reactions which ensued in animals when they were given various other crude and so called purified thyrotropic preparations. Since the unit potencies of these preparations differed from that of antuitrin T

any comparison of their effectiveness with that of antuitrin T was not undertaken.

METHODS

The several groups of animals that had received various thyrotropic preparations for varying lengths of time were as follows:

A. Antuitrin T was administered in daily amounts containing 25 Junkmann-Schoeller units¹ to 15 thyroidectomized animals, 7 of which had also been orchectomized. Four intact animals also received this product. The period of administration was from 3 to 32 days.

B. The solvent for antuitrin T including the preservative but without the pituitary ingredient, was given in comparable daily doses as a control to 4 intact animals.

C. Five intact animals with comparable body weights were fasted, to induce a loss of weight like that sustained by some of the animals receiving antuitrin T. These served as controls for changes sustained solely from loss of body weight.

D. A so called purified thyrotropic factor was given to 8 thyroidectomized animals in daily amounts containing 2.5, 5.0, and 10.0 Rowlands-Parkes units² for periods of from 7 to 39 days.

E. Crude thyrotropic preparation was given in daily amounts containing 5 and 10 Rowlands-Parkes units to 10 thyroidectomized animals for periods of from 8 to 24 days.

F. The specific metabolic principle, which is a fraction of a thyrotropic preparation and which failed to produce thyroid hyperplasia, was administered in daily amounts of 1 cubic centimeter (later raised to 2 cubic centimeters) to 4 thyroidectomized animals for periods of 6 to 8 days.

Most of the animals were killed by ether. As a control procedure, a few animals were killed by lethal doses of pentobarbital sodium. Axillary, cervical, periurethral, orbital and testicular fat and temporal, cardiac, and extraocular muscles were removed and fixed in 10 per cent solution of formalin. The entire orbital contents were dissected from the bony orbit as a single unit. This mass of tissue was fixed and sections were made through the entire substance just posterior to the globe so that a cross section of all retrobulbar tissues was obtained. Sections were made of the liver, kidney, spleen and representative lymph

¹ A unit is that amount of hormone which, injected daily for three days, causes 25% of animals (40-50), recognizable hypertrophy of the epithelium and disappearance of colloid in the thyroid of guinea pigs 250 to 350 gm in weight (Potency as based on assay by manufacturer).

² A unit is that amount of extract which gives daily for 5 days will cause the thyroids of mature female guinea pigs weighing 300 grams to double their weight or attain weight of 60 milligrams. (Rowlands-Parkes were described as weighing approximately 30 milligrams (4).) (Potency was based on assay by manufacturer and confirmed by the author).

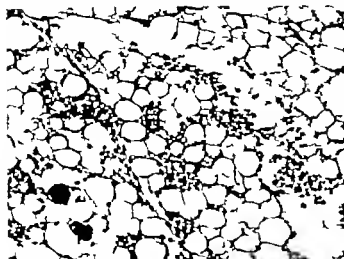


Fig. 2. Changes induced in the testicular fat tab of a thyroidectomized guinea pig by 0.5 cubic centimeters of antuitrin T daily for 3 days (hematoxylin and eosin $\times 118$)



Fig. 3. Changes induced in the testicular fat tab of a thyroidectomized guinea pig by 0.5 cubic centimeters of antuitrin T daily for 13 days (hematoxylin and eosin $\times 118$)

nodes. In some animals sections of the ureter and of the small intestine were prepared.

Two techniques for histologic preparation were employed. Frozen sections were cut and stained with scarlet red and counterstained with hematoxylin. Paraffin sections were stained with the routine hematoxylin and eosin stains. In instances in which connective tissue changes were observed Mallory Heidenhain and van Gieson stains were applied. In some instances mucicarmine stains were used.

At the time of thyroidectomy and orchectomy biopsies were taken of cervical and testicular fat. These tissues were subsequently contrasted with those obtained from the same animals after thyrotropic hormone had been given to them.

The changes in each tissue were studied and recorded by grading the degree of change on the basis of 1 to 4 (1 being the smallest discernible change and 4 being the most striking degree of change).

RESULTS

A. Gross changes induced in tissues by thyrotropic hormone preparations. Antuitrin T produced the most striking gross changes in animals regardless of the presence or absence of the thyroid. Fat from most of the fat depots had a redder appearance and possessed a more firm and rubbery consistency than did fat of normal animals. This gross change was most striking in the first few days of administration of antuitrin T. After longer periods the fat depots were extremely depleted of fat and, in the place of the fat there was found a translucent gelatinous material (Fig. 1). The most striking changes in fat occurred in animals which had lost the most

weight. Although some of the animals treated with antuitrin T had lost considerable weight in many cases the volume of the gelatinous fat depots was not materially decreased. This was in contrast to the markedly decreased volume of the fat depots of the fasted control animals which had lost comparable amounts of weight. In the fasted guinea pigs which had lost considerable weight and possessed depleted fat depots, the fat remained soft and showed little if any of the gelatinous character. The fat in animals which were given the preparations, other than antuitrin T did not differ grossly from the normal.

In animals which had received antuitrin T for only a few days the skeletal muscles were rather pale and had a tendency to tear easily when stretched. The livers of such animals were extremely pale slightly enlarged and very friable. But after more prolonged administration of antuitrin T the skeletal muscles and liver returned to a more normal color and consistency. Color changes similar to those in the liver were induced in the kidneys.

In the animals given antuitrin T the connective tissue septa of the harderian glands were edematous and appeared as dark partitions between the lobules, much in contrast to these septa in normal glands.

In the animals which received the crude thyrotropic preparation the connective tissue septa of the harderian glands were less edematous than those in animals receiving antuitrin T. In certain of this group which gained less weight the livers were rather pale and mottled and the fat depots were abundant occasionally more glossy and edematous than normal.

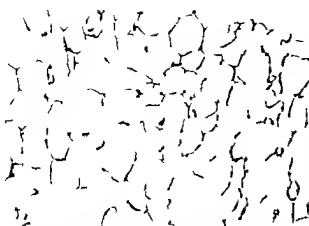


Fig. 4. a, left, Axillary fat of normal guinea pig. b, Changes induced in the axillary fat of a thyroidectomized



guinea pig by 0.5 cubic centimeter of antuitrin T daily for 3 days (hematoxylin and eosin $\times 18$)

The tissues of the animals which received the solvent for antuitrin T and of those which received the so called purified thyrotropic factor or the specific metabolic principle did not show any of these gross changes such as occurred in the animals receiving antuitrin T or the crude thyrotropic preparation.

B Microscopic changes induced in tissues of animals receiving antuitrin T. The most consistent change observed in the tissues of animals receiving antuitrin T was the appearance of large numbers of mononuclear and polymorphonuclear leucocytes containing fat droplets a condition not ordinarily seen in such cells of control animals. This cellular reaction was accompanied by varying degrees of edema. These fat-containing cells occurred not only in the orbital tissue but throughout the connective tissue generally. Fat tissues throughout the body were markedly

altered (Figs. 2, 3, 4, and 5). The thin septa of connective tissue fibers between the fat cells were three to four times their normal thickness. Clusters of large and small mononuclear and polymorphonuclear leucocytes had infiltrated into these thickened septa. In some areas where the reaction was extreme, a homogeneous, faintly staining material had formed within these connective tissue spaces to such an extent that the fat cells appeared to be floating in a matrix (Figs. 2 and 4). This cellular reaction resembled very closely the histologic pattern of the reparative processes seen in fat necrosis accompanying traumatized tissue.

In animals given antuitrin T for short periods, there were more polymorphonuclear cells containing more fat droplets and there was more edema but only slight proliferation of connective tissue. In animals given this preparation for

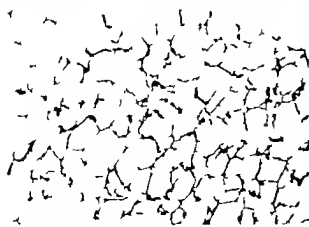


Fig. 5. a, left, Orbital fat of normal guinea pig. b, Changes induced in the orbital fat of a thyroidectomized



guinea pig by 0.5 cubic centimeter of antuitrin T daily for 9 days (hematoxylin and eosin $\times 8$)

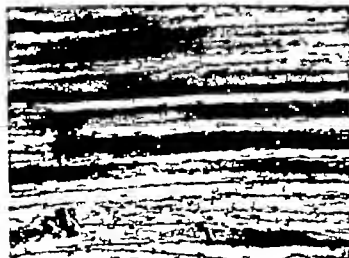


Fig. 6. Fat laden skeletal (temporal) muscle fibers of an intact guinea pig that had received 0.5 cubic centimeter of antuitrin T daily for 2 days (scarlet red and alum hematoxylin $\times 96$).

longer periods, there were fewer polymorphonuclear cells, more lymphocytes, more large macrophages and fibroblasts and more collagenous connective tissue but less edema.

In sections of the cardiac and skeletal muscles of injected animals there was but little cellular infiltration although there was more than in sections of normal muscle. In preparations stained with hematoxylin and eosin a mild degenerative process of muscle fibers characterized by a loss of striations and a granular appearance of the fibers, was evident. This occurred in a spotty manner without apparent relation to the blood supply or to any other recognized anatomic feature.

These changes in muscle took on added significance when fat stains were applied to these same muscles for it was found that the fibers, in the same spotty fashion, were loaded with tiny droplets of fat (Fig. 6). In some sections of a single fiber the fat was in great abundance while in other places along the same fiber relatively little change from the normal was found. The degree of change in various muscles in the same animal showed considerable variation. The extraocular muscles when studied in this way were almost always found to contain more fat than any other muscles. At times the lymphocytes and the large macrophages were more abundant about those portions of the muscle containing the most fat; however in other instances the most affected muscles contained no new cellular elements. These macrophages and lymphocytes were always most abundant in connective tissue bordering muscle fibers or in perivascular locations.

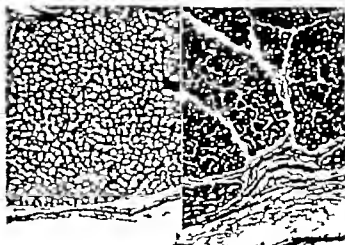


Fig. 7. a, left, Normal harderian gland ($\times 35$). b, Marked edema of the connective tissue around and within the harderian gland of a thyroidectomized guinea pig in which exophthalmos had been induced by administration of antuitrin T ($\times 35$).

The same general trend of the reaction that was observed in connective tissue and fat, namely, less fat in tissue macrophages as treatment continued, occurred also in muscle tissue. Animals treated for a short time contained much more fat in the muscle fibers than those treated for longer periods. A very close correlation was noted between the presence of fat in the muscle fibers and the degree of myasthenia produced by antuitrin T. This correlation held true even in the animals



Fig. 8. Edema in skeletal (temporal) muscle following the administration of 0.5 cubic centimeters of antuitrin T daily for 13 days to a thyroidectomized guinea pig (hematoxylin and eosin $\times 140$). This is an example of a striking degree of edema in muscle. There was rather high grade edema of connective tissue (see Figs. 3 and 4) throughout the body of this animal as well as marked exophthalmos. The temporal muscle was chosen because by its position edema is least likely to develop on the basis of dependency.

treated for longer periods when fat in muscle was rarely found and myasthenia was infrequently observed.

The large, pale, friable livers observed in the animals receiving antuitrin T for a short time contained relatively large amounts of fat but the livers of those animals given the preparation for longer periods contained less fat. In those animals in which the kidney was studied the droplets of fat were present in cells of the tubular epithelium. However here again the amount of fat present was readily correlated with the duration of the injections and corresponded well with the presence of fat in muscle and in liver. Fat droplets were seen too in the large reticuloendothelial cells of the lung in the spleen and in lymph nodes of animals which possessed pronounced changes in fat elsewhere in the body. Likewise the epithelial cells of the ileum and bronchi contained tiny droplets of fat in their cytoplasm. Excessive quantities of fat were found in the lacteals of the small intestine.

Edema in the orbit was most easily recognized in the septa of the hardenian glands (Fig. 7). It was present, too, in the connective tissue of the fat in the orbit (Fig. 5) and in other fat depots of the body (Fig. 3). In a few animals which had had striking exophthalmos, extensive edema had developed in the temporal muscle (Fig. 8). In many animals edema was either present in small amounts or absent entirely from these muscles.

The infiltration of a homogeneous, faintly staining intercellular substance in connective tissue especially in adipose tissue, appeared quite consistently not only in the orbit but elsewhere in the body (Figs. 2, 3, 4, and 5). Mucicarmine stains did not reveal the presence of mucin but van Gieson and Mallory Heldenheim techniques indicated that this material was probably collagen of young connective tissue. This homogeneous material was associated with the cellular reaction described previously and was usually most prevalent after a period of treatment when the acute phase of the cellular reaction was subsiding. The effect of antuitrin T on the tissues of intact animals is the same as seen in thyroidectomized animals when one considers equal periods of treatment. The general impression was that the edema that developed in normal animals was somewhat less than that in thyroidectomized animals.

The tissues of the group of animals which received the solvent for antuitrin T did not sustain these histologic changes. This, therefore would seem to eliminate the possibility that the solvent or preservative was the causative factor in pro-

ducing the tissue changes. Exophthalmos, it will be recalled did not develop in this group of animals.

Because the most striking changes in fat occurred during the early administration of antuitrin T and because it was during this period that the animals lost the most weight it seemed advisable to know whether phagocytosis of fat occurred in animals which lost weight rapidly for other reasons, for example, fasting. It is known that fasting is accompanied by a rapid mobilization of fat from depots and that this fat is subsequently found in abundance in the liver.

In the fat depots of fasted animals, in which the fat was extremely depleted nuclei of fat cells persisted and there was a relative increase of connective tissue with few lymphocytes, macrophages, and polymorphonuclear leukocytes. Fat droplets were occasionally seen in these cells but in negligible amounts when the fasted animals were compared with animals which had received antuitrin T. In no instance was this finding more than minimal in the fat depots of fasted animals.

The presence of fat in muscles was also found in fat-stained preparations from fasted animals but to a very mild degree. There was also a slight amount of edema in the connective tissue of some of the fasted animals.

It has been shown by the author in experiments described elsewhere (20) that thyroidectomy alone was not followed by any appreciable increase of cellular elements or edema in connective tissue.

C. Microscopic changes induced in the tissues by other thyrotropic preparations. The purified thyrotropic factor in the amounts administered, resulted in the appearance of some fat in the liver but no increase of cellular elements in connective tissue was recognized and phagocytosis of fat by such cells was not graded more than 1. In the hematoxylin and eosin preparations there was some evidence of an increase of the number of macrophages but the deposition of new connective tissue was not demonstrable. Muscle degeneration however occurred to an appreciable degree (grade 3) in only one animal, which was an exception and in which some exophthalmos had developed. Edema in all tissues including the orbit was more noticeable than in thyroidectomized controls, and a very slight increase in connective tissue had been induced.

Generally speaking the tissue reaction in the animals given the crude thyrotropic preparation in the amounts indicated was less pronounced than that found in animals given antuitrin T. However it was more marked than the equivocal

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changes induced by the so called purified thyrotropic preparation. The degree of edema in these animals resembled that of animals treated with antuitrin T and occurred throughout all the connective tissues examined. There was an abnormal increase of the number of tissue macrophages but polymorphonuclear cells were rarely seen. The presence of fat droplets in tissue macrophages, however, was considerably less than in animals given antuitrin T. In only about a half of the animals such intracellular fat was demonstrable however it was relatively marked in a few animals which had gained less weight. The appearance of fat droplets in muscle fibers was moderate in most animals. It was not demonstrable at all in one animal which was conspicuously different in other respects. The abnormal presence of fat in other organs was variable and the homogeneous faint staining material was not found in these animals.

In animals which received the crude thyrotropic preparation in the amounts indicated less striking exophthalmos developed than in animals treated with antuitrin T. Edema of connective tissue was a prominent feature but the cellular reaction associated with the abnormal presence of fat in many locations and the deposition of connective tissue was not as striking. The shortest period of observation of the animals was 8 days and on the average these animals were observed longer than were those given antuitrin T. The experience with antuitrin T has shown that the acute phase of the reaction occurred early in the course of administration of mononuclear cells. The presence of moderate numbers of mononuclear cells in the tissue of animals treated for longer periods with the crude thyrotropic preparation may bear witness to a more acute reaction that had preceded.

The tissues of the animals which had received the specific metabolic principle in the amounts indicated were of interest because in most instances they appeared to be unchanged. One animal which had lost some weight because of apparent toxicity of the product had a grade 3 edema in the orbit but this was not found in other tissues, and the animal had not become exophthalmic. In some animals very small amounts of fat were demonstrated in muscle fibers.

COMMENT

This report is specifically concerned with certain changes which were observed in the orbit and in various other regions and organs of guinea pigs and which ensued on the administration of antuitrin T for varying periods. In addition, it

includes brief reference to results obtained in comparable animals on the administration of certain other preparations including the solvent for antuitrin T a crude, and a so called purified thyrotropic preparation the potencies of which had been assayed in terms of units not comparable to those of antuitrin T. Since antuitrin T was assayed on the basis of one type of unit and the crude and purified preparations were assayed on the basis of another type of unit, it is not possible to compare the effectiveness of these preparations with that of antuitrin T on the basis of unit potency. It is however, possible to relate the exophthalmos to the tissue changes in any one animal or in any group of animals, irrespective of the preparation which produced the changes.

As hitherto shown (21) antuitrin T produced marked exophthalmos. The crude thyrotropic preparation in the amounts administered was less effective and the purified thyrotropic preparation in the amounts given was least effective of all in producing exophthalmos. The degree of cellular reaction the edema and the connective tissue changes which occurred in these three groups of animals were most marked in those receiving antuitrin T less so in those receiving the crude preparation and least so in those receiving the so called purified product.

This study has shown that a general systemic alteration in fat depots occurred in animals which received antuitrin T. These depots were rapidly depleted of their fat contents, which were replaced by a more translucent gelatinous material. These changes were associated with the infiltration of large numbers of polymorphonuclear leucocytes and tissue macrophages which were loaded with tiny fat droplets. The impression was gained that these large macrophages had phagocytosed fat and were transforming into fibroblasts still containing fat, and ultimately gave rise to connective tissue fibers. Much edema was associated with this reaction. Further evidence of the changes in the fat of the body was shown by the appearance of large amounts of fat in the liver kidney and skeletal and cardiac muscle and in the epithelium of bronchus, ureter, and the ileum.

It is probably of considerable clinical interest that a relationship was recognized between the appearance of fat in the skeletal muscles and profound myasthenia that developed in animals shortly after antuitrin T was given. These cellular reactions as well as exophthalmos occurred in animals regardless of the presence or absence of the thyroid or the testes in the animals in which there was the appearance of fat in abnormal quantities in the foregoing organs.

droplets of fat were also observed in the reticulo-endothelial cells of the lungs, lymph nodes, and spleen. It would seem that the appearance of fat in these specialized cells constitutes a part of the same generalized systemic reaction throughout the body. The results of these experiments suggest that there is a generalized alteration of fat metabolism and that the connective tissue reaction and the exophthalmos may be associated with it.

These observations confirm the opinion of Smelser (45) that tissue reactions may occur in other locations than the orbit. The degeneration of skeletal muscle fibers, illustrated with the hematoxylin and eosin preparations described by Paulson (37) was apparently due to the presence of fat in these muscle fibers. Whether the lymphocytes and macrophages in muscle described by him as well as others are present to remove the fat or to carry away products of cellular degeneration is unknown.

The demonstration of these cytologic changes in tissues, resulting in the ultimate deposition of connective tissue in the involved regions, supports the opinion of Friedgood (24, 26) and Alrd (1, 2) that exophthalmos, after being maintained for a period, becomes irreversible. This also supports the observation of Smelser (47) that there is an increase of the residue which remains after the extraction of water and fat from orbital tissues of animals treated with thyrotropic hormone.

It is well known that pituitary extracts cause an increase of liver fat (3, 7, 10, 30). Barrett, Best, and Ridout (5) showed by labeling fat molecules that fat was transferred from the various depots to the liver. But the possible relation of this observation on the liver to conditions which induce exophthalmos has not been suggested.

Several terms have been given to unisolated substances in the anterior pituitary which influence the mobilization of fat, but their chemical relationship or similarity to the substances which stimulate the thyroid gland is uncertain.

The fact that fasted animals show some of these tissue changes, especially those relating to fat metabolism, confuses somewhat an interpretation of the mechanism of such reactions to antuitrin T. The changes produced by the hormone are not identical with those induced by fasting. Furthermore, they are far more extreme than those seen in the fat depots of fasting animals. It has been pointed out (31) that thyrotropic hormone had toxic effects on animals even before the thyroid response was fully elicited. It is known that animals, when given thyrotropic hormone do not withstand surgical procedures

well (14). In a similar manner fasting animals (49) or animals recovering from surgical procedures (21) do not well withstand the administration of thyrotropic hormone.

The observations of increased fat in the epithelium and lacteals of the small bowel of these animals receiving antuitrin T may have some relation to the observation of Rony and his associates, who found an increase of fat in the lacteals of fasted animals. In a similar way the observation by Binet and his associates of fat globules in the bronchial epithelium and round cells of the lung in fasting animals is recalled by these observations, which show the presence of fat in the bronchial epithelium of animals receiving thyrotropic hormone.

It is quite possible that there may be some relationship between the myasthenia produced in these animals and the myasthenia in exophthalmic goiter. Plummer and Winkler found a positive correlation between the loss of quadriceps strength and the exophthalmos in exophthalmic goiter. These systemic changes may in some way be related to the exophthalmos and to the myasthenia produced in animals by administration of antuitrin T.

SUMMARY

Tissues of animals which during life had been given various thyrotropic hormone preparations and on which very accurate records of the development of exophthalmos had been made were studied grossly and by several histologic techniques.

Antuitrin T which produced the most striking exophthalmos was found to produce gross and microscopic changes in connective tissue not only in the orbit but elsewhere in the body.

The study showed that as a result of the administration of thyrotropic hormone there was a generalized alteration in fat depots, which are rapidly depleted of their fat contents and are replaced by a more translucent gelatinous material. Histologically these changes in fat and connective tissue are characterized by the presence of edema and the infiltration of large numbers of polymorphonuclear leucocytes, lymphocytes, and tissue macrophages. Early in the reaction the polymorphonuclear leucocytes and tissue macrophages are loaded with tiny droplets of fat. Later an increase of new connective tissue is evident. This reaction was correlated with the exophthalmos which had previously developed in these animals.

Skeletal and cardiac muscle fibers during the early period of administration of thyrotropic

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hormone lost their striations and were found to contain multitudes of tiny fat droplets which lined up in a pattern representing the cross-striations of the fibers. New cellular elements were present among muscle fibers. Considerable significance was attributed to a close correlation between the presence of fat in the muscles and the myasthenia present in these animals before death a fact which may have clinical correlations.

Further evidence of alterations in fat during the early administration of thyrotropic hormone is the presence of large amounts of fat in the liver kidneys and epithelium from several locations, as well as large phagocytic cells of the lungs spleen and lymph nodes.

These changes took place regardless of the presence or absence of the thyroid.

Since the completion of this investigation there has appeared in the literature a study by Pochin on exophthalmos in guinea pigs, some of which is confirmatory and some contradictory of the results of the present study. Pochin, E. E. Exophthalmos in guinea pigs injected with pituitary extracts. Clin. Sc., 1944, 5: 75-91.

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EDITORIAL

SURGERY Gynecology and Obstetrics

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MAY 1946

THE USE OF COMPRESSION IN THE TREATMENT OF INJURIES

THE use of compression to arrest and prevent escape of blood and serum into body tissues represents a surgical principle which, to use Homans words, has been "perennially discovered, discredited, forgotten, rediscovered and reaffirmed."

The subcutaneous rupture of blood vessels and the rapid escape of blood and serum into soft tissues are of frequent and everyday occurrence. The blow over the eye or forehead, the crushing of a finger tip, the twist of an ankle—all lead to rapidly forming swelling and the subsequent discoloration that indicates that the blood vessels have been torn and blood has infiltrated the surrounding tissues. Severe contusions and crushing injuries of soft tissue and bone are followed by the same train of events in a more exaggerated form.

When one is confronted with an open wound from which active bleeding is taking

place one's first instinct—whether layman or surgeon—is to apply pressure to stop the bleeding. The surgeon in the operating room almost daily instinctively and logically presses gauze sponges or "laparotomy pads" against a bleeding surface to arrest oozing. The same principle can be employed, and with almost equal effectiveness in the control of bleeding which does not meet the eye as a rapidly welling pool of blood but which is accumulating under the surface in direct ratio to the extent of injury and the elasticity of the overlying tissues.

When one recalls what happens when a considerable quantity of blood infiltrates soft tissues—the harmful compression of fragile living cells, the slow disintegration of red cells, the fibrosis that follows the absorption of serum and disintegrated corpuscles—it becomes a matter both of logical treatment and of importance to arrest such bleeding as promptly as possible. When one recalls further that after an extensive crushing injury the loss of blood into the soft tissues can be so great as to lead to shock and threaten life, the arrest of such hemorrhage becomes a matter of life and death. The most certain means at our command of controlling such bleeding is by smooth firm compression of the affected area.

There is a second important group of cases in which similar conditions obtain—those in which blood without red cells escapes rapidly into the surrounding tissues and leads to the same local and general symptoms of swelling, distention of tissues and fluid loss. Whatever the cause of the fluid loss that rapidly follows exposure to extremes of heat and cold—in increased permeability of damaged capillaries,

local vasodilator reaction which causes the region (surrounding a burn) to become an open shunt with capacity to contain a maximal amount of intravascular blood¹ or whether still other factors at work—every worker interested in the treatment of burns or of injuries due to freezing has been concerned with the rapid loss of fluid into the tissues and with the serious effect of such loss both on the tissues at the site of injury and on the entire body mechanism. With the concentrated attention that has been given to these injuries in recent years it has become increasingly apparent that the prompt application of pressure over the injured area is the most certain and effective means of preventing and checking fluid loss and of arresting the 'white hemorrhage' which is so important a factor in the clinical picture that develops rapidly after severe injuries due to extreme heat and cold.

A third group of cases in which the use of compression is an important factor in bringing about recovery is well illustrated by a simple case report from Sampson Gamgee's *Surgical Lectures* published in 1883²

On the 18th September 1879 a bloated middle-aged man came before me in the out patient room with his right leg big, tense, purple, and exquisitely tender.

"The man had earned his living as a hawker and had been a hard drinker. On admission the right leg was of greatly increased size, and of deep purple colour, the skin tense and shining and intensely sensitive to the slightest touch. Circular measurement of the two legs gave the following result:

	Right	Left
At the middle of the patella	18½ inches	17 inches
Six inches below	18 inches	7 inches
Round the malleoli	14 inches	1 ¾ inches

Placing the man on his back and raising the foot I enveloped the limb in a layer of cotton wool, over which I constructed a compressing millboard and banded with laticework.

"September 19th, 9 a.m.—After the lapse of 13 hours bandages very loose from the considerable

subsidence of swelling which has taken place in the twelve hours since they were applied. I applied another bandage with firmer pressure and suspended the limb. The patient had passed a comfortable night, with the exception of some pain between midnight and 5 a.m. He is now perfectly comfortable.

8 15 p.m.—Has been very easy all day. On removing the apparatus the limb is much paler and softer and scarcely tender on pressure. The patient's spontaneous expression is 'It is wonderful how I can bear it handled now and I could not stand a feather touching it last night. The following are the circular measurements of the right leg:

		Decrease in 24 hours
Mid patella	17 inches	1 ¾ inches
Six inches below	15 ¾ inches	1 ¾ inches
Round the malleoli	13 inches	1 inch

The strips of pasteboard were now re-moistened, to fit the shrunken limb and banded to it, lattice-work fashion, over cotton wool with increased pressure. The application last night though conducted most gently caused occasional exclamations of intense suffering but the patient bore it tonight, though executed comparatively roughly without the least pain. The same process was repeated daily to follow up the decreasing limb with equable pressure and at the end of a week, the two legs were of equal size.

Admitting the beneficial influence of the horizontal position of the body and of the suspension of the limb in the flexed position, there can be no question that the immediate relief of pain and the rapid subsidence of swelling were chiefly due to smooth elastic pressure."

Gamgee cites a number of similar cases in which disabilities resulting from widespread exudation through the soft tissues associated with a chronic inflammatory process responded rapidly to the application of compression and immobilizing splints. Further more he points out that many English, French, and German writers during the century preceding had repeatedly emphasized the importance of compression in the treatment of injuries and of chronic inflammation—a method "forgotten rediscovered and reaffirmed. Ironically perhaps, Gamgee obtained such good results by adhering to sound surgical principles that he was reluctant to accept the teachings of his friend and classmate Lister.

It seems almost superfluous to repeat in a surgical journal Blair's emphasis on "The

¹Glenz, Wm. W. L., Gilbert, Helen H., and Drinker, Cecil K. *J. Clin. Invest.*, 1921, 21, 609.

²Gamgee, Sampson. *On the Treatment of Wounds and Fractures*. 1st ed. London. J. & A. Churchill, 1883.

EDITORIAL

Influence of Mechanical Pressure on Wound Healing' : but a few lines deserve repetition because so much of good surgical sense is compressed in them

There are chiefly four basic things to be gained by the use of properly applied mechanical pressure to wounds

"The elimination of dead spaces.

"The control of oozing.

"The limitation of venous and lymph stasis.

Blair V. P. The influence of mechanical pressure on wound healing. Illinois M. J. 924, 46 249-25

Limitation of the amount of plastic material that pours into the wound."

Fowler of the University of Minnesota said at a recent meeting in Minneapolis that an understanding and appreciation of the value of compression was one of the outstanding lessons learned during the war. Perhaps it has been so well learned that it will not again have to be rediscovered and reaffirmed

SUMNER L. KOCH

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

HOSPITAL CARE OF THE SURGICAL PATIENT: A SURGEON'S HANDBOOK WITH AN APPENDIX ON THE TREATMENT OF WOUNDS. By George Crile, Jr., M.D. and Franklin L. Shively Jr., M.D. Foreword by Evans A. Graham, M.D. Springfield, Illinois: Charles C Thomas, 1946.

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BURMA SURGEON RETURNS. By Gordon S. Seagrave, M.D., Maps by Phoo Lieng Sing and Lucas Manditch. New York: W. W. Norton & Co. Inc., 1946.

DIGITALIS AND OTHER CARDIOTONIC DRUGS. By EH Rodin Moritt, M.D. New York: Oxford University Press, 1946.

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AFECTACIONES VASCULARES QUIRURGICAS DEL ENCEFALO. By Alfonso Arenjo, F.R.S., F.A.C.S., and Enrique Ulibarri. Santiago: Central de Publicaciones, 1945.

NECROPSY. By H. Houston Merritt, A.B. M.A. (Hon.) M.D., Raymond D. Adams, M.A., M.D., and

Harry C. Solomon, B.S., M.D. New York: Oxford University Press, 1946.

NOTABLE NAMES IN MEDICINE AND SURGERY. By Hamilton Bailey, F.R.C.S. (Eng.), F.I.C.S., and W. J. Blahop, F.L.A. London: H. K. Lewis & Co. Ltd., 1946.

JOURNAL OF THE HISTORY OF MEDICINE AND ALLIED SCIENCES. Vol. 1 No. 1. New York: Henry Schuman, 1946.

PENICILLIN THERAPY AND CONTROL IN THE ARMY GROUP. Published under the direction of the Director of Medical Services, 21 Army Group with introduction by the Consulting Surgeon, 1945.

HIPPOCRATIC WISDOM FOR HIM WHO WISHES TO PURSUE PROPERLY THE SCIENCE OF MEDICINE. By William F. Petersen, M.D. Springfield, Illinois: Charles C Thomas, 1946.

APPLIED PHYSIOLOGY. By Samson Wright, M.D. F.R.C.P. London, New York, Toronto: Humphrey Milford, Oxford University Press, 1945.

KETTLER'S PATHOLOGY OF TUMOURS. By W. G. Barnard, F.R.C.P., and A.H.T. Robb-Smith, M.A. (Oxon.) M.D. (Lond.) 3 ed. New York: Paul B. Hoeber Inc., 1946.

SESIONES QUIRURGICAS PARA GRADUADOS, HOSPITAL RAWSON. By Ricardo Finochietto. Lecciones de cirugía. First and Second Series. Buenos Aires: La Prensa Médica Argentina, 1945.

HIPERTROFISMO FISTOPATOLOGIA Y TRATAMIENTO. By Jose Alberto Cadro. Buenos Aires: Lopez & Etchegoyen S.R.L., 1945.

PAGINAS DE CIRUGIA. By Enrique Finochietto. Buenos Aires: La Prensa Médica Argentina, 1945.

ORAL MEDICINE: DIAGNOSIS—TREATMENT. By Lester W. Burket, D.D.S., M.D. With a Section on Oral Aspects of Aviation Medicine by Major Alvin Goldshah, D.D.S. M.S., D.S. A.U.S. Philadelphia, London, Montreal: J. B. Lippincott Co., 1946.

AMBULATORY PROCTOLOGY. By Alfred J. Cantor, M.D. With a foreword by Beaumont S. Cornell, M.D. New York and London: Paul B. Hoeber Inc., 1946.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

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PLANS DEVELOP FOR 1946 CLINICAL CONGRESS OF THE AMERICAN COLLEGE OF SURGEONS

THE announcement in the March issue of SURGERY, GYNECOLOGY AND OBSTETRICS of the definite plans for holding the 1946 Clinical Congress of the American College of Surgeons at the Waldorf Astoria in New York City from September 9 to 13 has been greeted with enthusiasm. A large meeting and exception ally keen interest are assured. The four years without a Clinical Congress have been years impressively lacking in a focal point for intensive study of trends in surgery, and surgeons everywhere are eagerly anticipating the resumption of the annual meeting.

Progress does not stop when there is no Congress, of course, but the application of new techniques and ideas is delayed when there are no opportunities for the meeting of minds that a large international conference affords. The Clinical Congress makes a convenient annual milepost by which to calculate and to evaluate advances in surgery and it provides a spur to progress through this function and through its inspirational influence.

Surgeons need the stimulation that comes from directly hearing of new developments from the lips of those who helped to initiate them. They need opportunities to ask questions, to participate in discussions, and to observe other surgeons at work, both in the local hospitals and on the motion picture screen. The latter teaching device in particular is becoming increasingly profitable and popular as more good medical films are produced and at the Clinical Congress ample opportunity is provided for surgeons to view the newest and best pictures.

The Clinical Congress, as the previous article indicated, will be the usual five-day session, embracing forums on fundamental surgical problems

panel discussions, clinical conferences, symposia, demonstrations, films, scientific sessions, hospital conferences, exhibits, and the formal Presidential Meeting and Convocation. This year the Convocation will be a particularly momentous event, since in addition to the initiatives of the current year there will be present a great many of the accumulated total of 2,744 surgeons who were received into fellowship in absentia during the four war years in which no Congress was held. It will also be an occasion of reunion for the Fellows, both new and old, many of whom have been overseas on military duty much of the time since the Boston Congress in 1941.

The new officers of the College who will be installed at the Presidential Meeting and Convocation are Dr. Irvin Abell of Louisville, as President; Dr. Leland S. McKitterick of Boston, as First Vice President; and Dr. F. Phinley Calhoun of Atlanta as Second Vice President. The Presidential Address will be given by Dr. W. Edward Gallie of Toronto, the retiring president.

Plans are progressing for making the programs of all of the scientific sessions, morning, afternoon, and evening, provide the most comprehensive delineation possible of advances in surgery and related sciences during the five years since the 1941 Congress. The various surgical specialties, ophthalmology, otorhinolaryngology, neurology, orthopedics, obstetrics, gynecology, urology, plastic surgery, and the others, will be covered specifically and also as they are related to general surgery. The four-day hospital conference will be devoted to all phases of transition, period plans and problems. A detailed outline of the programs will be published in the next issue.

Advance registration and hotel reservations are urged upon all who plan to attend the Congress.

May, 1946

International Abstract of Surgery

*Supplementary to
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PENETRATING CRANIAL WOUNDS A SUMMARY OF METHODS USED IN MANAGEMENT

Collective Review

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INTRODUCTION

RECENT literature pertaining to the management of cranial wounds in World War II has added important new information to the older concepts of treatment. The reports which are continually reaching publication serve to advance our knowledge and unify opinion. Any general review of this subject must consider the present incompleteness of information. We propose merely to summarize the experiences of various observers to date in the interest of consolidating reports and to emphasize the application of the measures employed in war surgery to related civilian injuries.

This summary is devoted mainly to a consideration of penetrating wounds caused by bullet or shell fragment missiles (Fig. 1). Injuries of this class produced by forces peculiar to high velocity represent a unique neurosurgical problem. Penetrating types of civilian cranial injuries of low velocity present quite different requirements in care. The difference in the degree of destruction of scalp, skull and cerebral tissue dictates the differing principles in surgical management. The radical measures employed in the débridement of high velocity wounds are not required in the less destructive, low velocity civilian injuries (hammer, blackjack, rocks, knives, car door handles, electric fan blades, stationary objects). This distinction is made at the outset since only brief consideration is given to the usual low velocity type of penetrating wound as encountered in civilian practice.

The survey includes observations made in 300 patients with cranial wounds produced by missiles of high velocity and treated in the 36th General Hospital which was located in Italy and in France. Because of the hospital's location all types of wounds were observed including one group of 40 cases of late wound débridement in German prisoners of war (210, 211, 212). The civilian patients with gunshot injuries of the brain were treated at the Detroit Receiving Hospital and Grace Hospital during a period of 20 years.

Before the principles followed in the care of patients with cranial wounds in World War II are described a brief review is made of the history of the care of war wounds in general and of those historical factors and opinions marking progress in the care of cranial injuries. The time periods are divided for consideration as follows: Early World War I, Interim and World War II periods. The neurosurgical methods and technique employed in World War I are reviewed in some detail for comparative purposes. Brief consideration is given to the applicable physics of tissue destruction produced by high velocity injuries. A group of nonmilitary gunshot wounds of the brain was included in order to evaluate methods of treatment used in civilian practice.

HISTORICAL

EARLY PERIOD

It has been reported that the first use of gun powder by the English was in the Battle of Crecy in 1346 (100). The poisonous nature of the wounds so produced was described by Giovanni da Vigo (1460-1525), surgeon to Pope Julius II.

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who stated that all gunshot wounds are not only contused and burned (requiring moist applications) but also poisoned by the powder (requiring dessiccation), and hence difficult to cure" (120) "He advised cauterizing the wounds by means of boiling elder oil or actual cautery." Brauns Weig a surgeon of Strasbourg, and others agreed with this plan during the 15th century (80) A new era was thus begun in warfare attended with "superstitious terror" aroused by the use of the new weapons which produced remarkable noise and flame upon discharge and profound acute and late effects upon human tissue. In the attempt to reach the openings of entrance and exit and track of the ball were incised the wound dilated by tents or other means terebinthins or boiling oil poured into it irritating compounds and ointments applied and it was only after the wound was considered to be fully purged of its venom and foul humors by the extensive suppurative action thus kept up that cicatrization was permitted to be established" (95)

The 16th century marked the beginning of a revolutionizing treatment of war wounds in general. Alphonse Stenzen surgeon to Paul III from 1534 to 1549, in the early part of his career held the same views as Weig and Vigo as to the poisonous nature of gunshot wounds. He made important improvements in wound management, advising upon the search for balls, their extraction, and upon the subject of dressings (80) Later in this era Ambrose Paré (144) leading surgeon of the Renaissance and founder of military surgery as a science and art, merely continued the early practices, merely dressing wounds after applying a digestive (31) Maggi of Italy supported the doctrines of Paré, which were published in a treatise on gunshot wounds (80) Leone Botall, and Fallopius "at once embraced the views of these eminent masters and the employment of too complicated instruments for the extraction of balls deprecated trephining for depressed gunshot fractures of the skull advised the discontinuance of the application of fatty substances to gunshot wounds and insisted upon the antiphlogistic treatment (50) In this century Botallus (17) described foreign bodies in the brain Complicating cerebral abscess was recognized but was not drained even though it was recognized that death would result by expectant treatment Opinion was confused as to the wisdom of removing bone fragments from fractured skulls it was "believed wise to bore if fissure in the skull was present. Dyes were used

to detect the discontinuities of the skull, a practice employed in the hippocratic era (13) A "Treatise on Gunshot Wounds" by Thomas Gale appeared in 1563 and was the first English publication on military surgery This was followed in 1613 by the "Chirurgeon's Mate" by John Woodall in 1667 by the "Eight Chirurgical Treatises of Richard Wiseman" one of which was devoted to gunshot wounds, and in 1678 by the "Treatise on Gunshot Wounds" by John Brown (80) In the 17th century, agreement was reached about the value of opening the skull for the drainage of purulent collections and for subdural hematoma (125)

During the latter part of the 18th century (1792), Percy (149) in the *Manuel du Chirurgien d'Armée* wrote "The first indication of cure is to change the nature of the wound (gunshot) as nearly as possible into an incised one." This treatment by incision a return to older practices, was widely used, particularly by the French, the reason for its use being that "it was necessary to obviate tension and prevent strangulation of neighboring tissue by tumefaction caused by inflammation arising in the track of the projectile (95) The term "débridement" was used to describe this method of wound management. English surgeons opposed the French practice following the advice of John Hunter who recommended a simpler and more rational treatment in an outstanding treatise published in 1794 and entitled, "Blood, Inflammation and Gunshot Wounds." Incision of the wound was advocated only "when something can be done for the relief of the patient by the opening (securing a wounded artery) or the future good arising from it (106)

Heister (90 128) referring to cranial wounds in the 18th century made the following observation "Gunshot wounds which affect the cranium are for the most part attended with great danger For even those which appear very slight externally frequently bring on terrible symptoms by the concussion of the internal parts which they shattered, or the internal laminae of the cranium are case the extravasated blood has no vent, nor can splinters of the cranium be extracted. Death therefore must be the issue unless prevented by the trepan

The Napoleonic Wars which ended in 1815 marked new progress in the care of gunshot wounds of all types. Mr Guthrie (81) quoted Sir Astley Cooper as stating that in the Peninsula War between 1808-1815 "the art of surgery received from the practical experience of that war an impulse and improvement unknown to it before.

Baron Larry (117) in his memoirs of the Napoleonic campaign in Russia. Germany and France clearly stated the principles which he followed in the treatment of cranial wounds. He reported that in a wound of the head accompanied by a fracture of the cranium should the fragments of bone be displaced and driven internally so as to injure the brain and dura mater the trephine is indispensable. When the foreign body which has caused the wound is enclosed between the pieces of bone or has penetrated into the interior of the cranium—the case is again one which demands the application of the trephine. Finally, when the surgeon is assured of the existence of effused fluid under the cranium, this instrument is also indicated. He believed that the operation should be performed as early as possible recognizing that 'inflammation is generally established in the meninges after the first twenty four hours succeeding the occurrence of the injury. Guthrie (84) held similar views, subscribing to operative treatment based upon observations made in the Peninsular War. After suggesting that a cranial wound be examined with a blunt, flat probe to determine the extent of damage, he raised the question 'What is to be done when depression and breaking down of the inner table have been ascertained? There can be no hesitation—that in all such cases the trephine should be applied although no symptoms should exist, with a view to anticipating them. The old doctrine, it may be said in regard to fractures generally is revived in these cases but on a principle with which our predecessors were not sufficiently acquainted. A patient very often survives a mere depression of the skull he may and occasionally does, survive a greater depression of the inner than of the outer table but it has not been shown that he ever does survive and remain in tolerable health after a depression with fracture of the inner table when portions of it have been driven into the dura mater. The result of my experience has rendered it imperative to remove at once all portions of bone or foreign substances which have materially injured the dura mater although no symptoms of compression should be observed. Hennen (92) emphasized the importance of trephine for compression without fracture. 'Where there is no wound the case becomes dubious and we are reduced to act upon probability founded upon gestures of the patient, his sensibility to pain upon pressing on a particular spot, or we may be guided by what the French surgeons place much dependence on viz. the existence of paralysis, which is most commonly on the side of the body opposite to the compressed portion of the brain



Fig. 1. Examples of penetrating missiles removed from the brain. Tiny bone chips and particles of clothing are present on the surfaces of the shell fragments.

The military operations in Algeria (1846) in Schleswig Holstein (1849) and in the Crimean War (1854-56) presented opportunities to test again the applicability to military practice of the great improvements accomplished in the civil practice of surgery in Europe since the termination of the war in 1815. The practice generally, of 'what has been styled conservative surgery' characterized the interlude between wars (95).

The trend toward conservatism in cranial surgery as well as in general surgery was demonstrated by the views expressed and by statistics which began making their first appearance. Longmore (95) pointed out that a gunshot wound of the head had previously been an indication in itself for the use of the trephine, that earlier in the 19th century trephine was used for injuries with out fracture. Such preventive trephine has been proved to be useless as well as dangerous and is universally acknowledged not to be an admissible operation. He stated that the majority of the English surgeons after the Peninsular War limited the use of trephine to fractures with depression causing interruption of cerebral function, fractures with bone indriven into the cerebral tissue and where an abscess had developed and was capable of evacuation. The trend was to confine the practice of trephine 'within still narrower limits. Stromeyer (95) an experienced German surgeon reported 41 gunshot fractures of the skull with depression. Of the 41 cases, 7 terminated fatally. Of the 34 patients who lived, only 1 was trephined and this was the only case of trephining which gave a favorable result in all three campaigns (Schleswig Holstein 1849). Stromeyer had earlier advocated trephine but stated in his *Principles of Military Surgery*

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that he had abandoned the practice (183) Macleod (122) in *Notes on Surgery of the War in the Crimea* reported that 67 patients with penetrating wounds of the skull had all died. In the treatment of 851 cranial wounds the trephine was employed only 28 times and 24 of the patients died. Thus the modest success of trepanation, based upon the results in two wars, resulted in endorsement of the modern treatment of expectancy and the avoidance of operation except in rare cases (122).

Macleod reported that the teaching of all was to lead us to wait to purge the patient thoroughly to remove only such pieces of bone as could be got at with the forceps and which were quite detached and loose to bleed, if need be, locally and even generally to use cold applications when there was a fear of inflammation to enjoin perfect rest, not only to the body generally but, if possible, to the special senses also by isolating the patient and thus removing the stimuli to their exercise to enforce the lowest diet and to continue all this treatment for a long period even after all danger seemed past and finally to treat any incidental complications on general principles.

This extract is not only expressive of the opinions of a single individual but may be regarded as embracing the views of the majority of surgeons of this period (80).

Information resulting from the War of the Rebellion in the United States (126) raised some doubt as to the reasonableness of the conservative conclusions formed by the continental surgeons. Reports showed that successes attended surgical intervention in cranial wounds. Gross (80) published a comparison of the results of trephining compared with those of the expectant plan of treatment. Of 160 patients on whom the trephine was employed 60 per cent died and of 573 with serious conditions treated by expectancy 74 per cent died. Of 126 cases in which fragments of bone were elevated or extracted, or foreign bodies were removed 55 per cent were fatal. "After all operations of every kind the rate of recovery was 41 per cent. By the conservative or expectant plan only 25 per cent lived, making in favor of operative interference 16 per cent of recoveries." Gross (80) reviewed the plan of treatment of cranial wounds proposed by Neudorfer (137) who was so prejudiced against the trephine that he not only did not use it himself but advised that it be excluded from the armamentarium of the army surgeon. He summarized the views of Stromeyer (183) Pirogoff (155) Legouest (119) Williamson (217) Demme (51) and Matthew (125) in show-

ing the confusion of opinion. He pointed out that the trephine is employed by surgeons of known experience and high reputation for widely different lesions and symptoms—that with one, its results have been invariably fatal and is positively contraindicated under all circumstances. With another the results have been so favorable that its application is not restricted to a limited number of lesions (Pirogoff, Legouest, Williamson). The variance in the experience between the American surgeons and those abroad was ascribed by Longmore (95) to the fact that "the former did not restrict the application of the trephine to otherwise hopeless cases and to the difference in the effect of the old round ball and the sharp minie bullet.

Toward the end of the 19th century advanced opinion formulated the following policy in the management of cranial wounds "When irregular edges, points or pieces of bone or foreign substances are forced down and evidently penetrate—not merely press upon—the cerebral surface or where abscess manifestly exists in any known site and relief cannot be afforded by simpler means at the wound itself trephining is the proper operation but in all other cases harm will probably be avoided by abstaining from trephining while benefit will be effected by simply resorting to long-continued constitutional treatment (95). It was recommended that if operation was necessary "the earlier that it is done the better."

Three years following the War of the Rebellion (1867) Lister's principles of antiseptic were enunciated, although in the Franco-German Wars, wounds of all types continued to be treated by unclean methods. Injuries up to this period were caused mainly by muzzle loading rifles and large caliber balls, although in the latter part of the Crimean War muskets were being transformed into *armes de précision* with rifled barrels and smaller balls. There were few wounds produced by artillery fire (127).

The magazine breech loader was introduced in 1892 and the use of this weapon greatly influenced the type of wound produced and the resultant requirements in wound care. Used during the Spanish American (1898) and the South African Wars (1899-01) this type of rifle fired a conoidal type of missile which resulted in a minimal degree of track damage (127). Wounds thus produced were effectively treated by means of a simple dressing and the results were satisfactory since in general, primary wound healing occurred (134). Since (176) Chief Surgeon in the Spanish Amer-

TABLE I.—19TH CENTURY MORTALITY STATISTICS IN CRANIOCEREBRAL WOUNDS¹ (95)

Authority	Injury	Cases	Deaths	Per cent
Surg. Report O. No. 6, War Dept. Surg. Gen. Office, 1864, pt. 9 (War of Rebellion, U.S.A.)	Gunshot fractures and injuries of cranial bones	704	305	43.7
T. P. Matthews Staff Surg. B.A., Crimea War (1854-56)	Gunshot wounds of head, of which 30 were contusions, fractures, penetration, or perforation	893	170	19.0
M. Chenu, Crimea Report (1854-56)	Gunshot fractures of the cranium	73	341	74
M. Chenu, Austro-Franco-Italian War of 1859	Wounds of head from all causes—contused, complicated undetermined, contusions, and unspecified (same indications) injuries	779	498	63.8
	Complicated wounds from gunshot balls			47.4
	Cannon balls or shell fragments	23		
Inspector-Gen. Mowat to New Zealand War (1863-65)	Scalp wounds	20	—	—
	Injury of cranial bones	8	—	—
	Fractures of cranium with wounds of brain			100
Macleod, statistics of Crimea War (1854-56)	Scalp wounds	630	8	1
	Fracture of cranium without known depression	6	23	37.7
	Fracture with depression	74	53	71.6
	Penetration of skull	67	67	100
	Perforation of skull	8	6	75.0
	Total	831	167	
Alcock (Spain)	Fracture	28	22	78.5
Ménière, War in India	Penetrating wounds of skull	9	7	88.4
Ménière, War in India	Penetrating wounds of skull			100

Extracted from Holmes, *System of Surgery* Philadelphia; Henry C. Lea's Sons, 1881.

can War reported that conservative surgery is the pride of the modern doctor on the field of battle. The stacks of amputated limbs that constituted such a gruesome and constant sight after every battle during the Civil War will never be seen again on the field of battle where modern surgery is practiced. The first aid dressing properly applied at the right time constitutes in the vast majority of cases, almost sure protection against infection of the wound. Prophylaxis has largely taken the place of operative surgery in the field. Our recent experience has demonstrated that the small-caliber rifle is the most humane weapon. If the wounded survive the immediate effects of the injury the prospects of recovery are good. What a contrast with the experience of the surgeons during the Civil War only thirty five years ago. At this point artillery was still little used and high explosive bombs and land mines were unborn instruments of destruction. Records of the period indicated that shell fragment wounds were invariably infected.

Prior to World War I, von Bergmann (203), Pappillon (143) and Doyot (55) recommended operative treatment for penetrating cranial wounds, employing an open method. Zoeger Von Manteuffel (205) in 1906 reported upon the

inadequacy of the conservative management when used in the Russo-Japanese War (1904-5). In the open treatment, after débridement of the comminuted bone, neither the dura nor scalp was closed which usually resulted in herniation of the brain and frequently the death of the patient. When this treatment was used in the Bulgarian Turkish War (1912-13) by Colmers (39) 70 per cent of all tangential gunshot wounds of the head with injury of the brain died of infection.

WORLD WAR I—GENERAL CONSIDERATIONS

Surgeons in World War I were unprepared to treat the type of wounds which they encountered because of two major changes in the instruments for wounding. The first was the increased velocity of missiles and the second was the frequent use of artillery fire in place of rifle injury to the extent that the ratio of gunshot wounds to those produced by artillery fire was reversed (18).

The concept at this period of a conservative management of war wounds of all types even with the knowledge of asepsis proved to be a failure. Established methods resulted in a high incidence of morbidity and mortality due to infection (66-189). Since antisepsis were in vogue, early use was made of various solutions to cleanse the

A policy of early operation débriment, and complete closure of the cranial wound was recommended by Barany (11 12 13) Willems (216) and Cushing (44) being first suggested in 1913 by Clairmont (36) and Colmers (39) Barany (11) particularly grasped the importance of the removal of devitalized tissue and closure of the dura and scalp without drainage. Cushing (44 127) announced a surgical policy in dealing with this type of wound in 1918 advising a catheter suction method of débriment. Ultimately this technique became a standardized procedure. In view of this fact, a detailed description is presented of the "Directions to Neurosurgical Teams" as outlined by Cushing (127)

It was first recommended that every scalp wound be considered as a potential penetrating wound of the skull and brain, a principle founded upon the observation of Hippocrates *Nullum capitis vulnus contemnendum*. As a part of the general attitude toward all wounds, an all or nothing plan of débriment was recommended. The observation was made that patients with penetrating wounds of the brain were able to tolerate transportation rather well before operation but poorly during the first few days after operation. It was held that craniocerebral cases "in more or less shock need not undergo a period of resuscitation. Local anesthesia combined with morphine was suggested as the most suitable anesthesia (49). The directions stated that the chief source of the high mortality in cranial wounds was infection—infection of the meninges direct infection of the brain leading to encephalitis, and infection of the ventricles."

The principle recommended in the operative technique was the removal of the contaminated wound margins and of all foreign material from the brain along with devitalized brain tissue. The "tripod" incision was advised to provide exposure of the underlying bone defect. The directions stated only in the case of large scalp defects is the switching of flaps necessary for closure, and it is questionable whether this is desirable. The technique suggested for the exposure of the brain track was the use of three or four perforations about the skull defect and the tilting up and removal of the bone "en bloc." It was advised to leave as small a bone defect as possible—a quarter of an inch margin beyond the defect suffices. The area of dural laceration should not be enlarged. The débriment of the contused brain and track can best be carried out with production of the least damage to the brain by gentle suction and irrigation with a soft rubber catheter. The catheter detects indriven bone fragments as well

as does the finger and then these can be picked out with delicate forceps. Metallic fragments of small size are surprisingly well tolerated. No mention is made in the technique outlined concerning the closure of the dura. Horrax (102) and Rand (158) have stated that it was usually not closed since, as the latter reported, the incidence of sepsis where the dura was closed was disproportionately high." Use was also made of dichloramine T in oil as an antiseptic "particularly suitable for infections in the central nervous system tissues."

Cranioerebral wounds were classified into 9 special groups based principally upon the type of damage produced. These groups and their percentage of mortality were as follows (127) (45)

- 1 Wounds of the scalp (about 5%)
- 2 Cranial fractures without dural penetration (10%)
- 3 Cranial fractures with depression and dural penetration but without extrusion of brain (20%)
- 4 Wounds usually of gutter type with brain extruding and indriven bone fragments (30%)
- 5 Wounds usually of penetrating type with indriven bone fragments plus metal (40%)
- 6 Wounds types 3 and 4 with penetration of bone and metal opening the ventricles (50%)
- 7 Craniofacial wounds or orbitofrontal or temporo-petrous wounds in which the ethmoid or petrous sinuses are open (60%)
- 8 Perforating or traversing wounds (70%)
- 9 Extensive bursting fractures with fatality usually due to trauma rather than infection (100%)

Harvey (88) recommended that every case in Group 2 should be explored and trephined that if the pathway from the external wound to the fracture is continuous then infection will, in many cases,—even with the simple depressed fracture without dural penetration—lead to meningitis or an abscess in a contused adjacent cortex. The statement was made in Harvey's report that patients in whom the dura was closed did "badly." As a general policy it was advised to allow the dura to remain open and in addition to drain the scalp with a small rubber wick to prevent damming back of the infection which would lead to meningitis or a cortical abscess. It was noted that in the gutter type of wound classified as Type 4 the probability of infection was of the greatest degree and it was held that wounds in which infection of the scalp or its intra cranial contents is problematical should be left open for free drainage. Penetration of the ventricle was found to result in a high mortality. (Cushing noted no recoveries in patients in which the ventricle was penetrated by a metallic pro-

jectile.) The management of wounds involving the orbit consisted of enucleation of the destroyed eye, and removal of the indriven bone fragments from the bony orbit and the pulped brain from the track. Bilateral decompressions were sometimes performed on extensive bursting fractures, but recovery was unusual.

The mortality rate including the results in all types of wounds with dural penetration was 37.5 per cent, being reduced from 54.5 per cent in the first group of patients to 28.8 per cent in the last group (44).

BRAIN ABSCESS, FUNGUS, AND MENINGITIS— WORLD WAR I

The report by the Surgeon General (127) summarizing the complications observed following penetrating wounds of the brain stated that the "principal cause of death in patients with head wounds after return from overseas was abscess of the brain. The abscesses frequently occurred in cases in which there were retained foreign bodies. In 219 cases Cushing encountered 8 instances of brain abscess within a few weeks of injury (24). In 37 cases studied by Sargent and Holmes (169, 170) the overwhelming frequency of brain abscesses in the first three to six months after injury was shown. 28 patients developed abscesses in that period, whereas the complication appeared in a 6 to 9 month interval in an additional 7 cases. The latest appearance of brain abscess was in the eighteenth month. The history of World War I recorded that multiple abscesses were found to be practically always fatal, and recovery from a brain abscess without a capsule was extremely rare (127). It was stated that the primary stage of abscess formation was one of septic encephalitis for which surgical procedures would give no relief. The ideal time for operation was after the formation of the capsule.

It is sometimes difficult to determine just how drainage of pus should be accomplished or whether simple aspiration with a needle should be made" (127). The procedures used for the drainage of abscesses varied in magnitude from the use of an osteoplastic flap to that of a simple trephine opening. It was noted that the best results in the treatment of this complication were obtained in the drainage of single abscesses with capsules. A second opinion stated that "consideration of all the facts justifies the conclusion that the most favorable time for accurately placing a drainage tube in an abscessed cavity is when the pus is first discovered. It is often possible to empty the abscess completely at this time, and there may be very little subsequent discharge. The drainage tube

should be fixed to the scalp and should not be removed until drainage has discontinued" (127). Brain abscess unrelieved by operation was considered to be fatal yet the vast majority of patients (97.5% in Sargent and Holmes series) died after the drainage of pus (138).

Fungus was observed to be one of the most frequent complications following the drainage of cerebral abscess, and the mortality was high. A fungus was the "result of an undrained abscess with or without hydrocephalus or an encephalitis." The notation was made that the treatment of the condition of fungus is as a rule unsatisfactory. It was held important that any associated accumulation of pus should be drained (127).

RETAINED FOREIGN BODIES—WORLD WAR I

Prior to World War I, a conservative attitude was taken toward the removal of foreign bodies within the cranial cavity as pointed out by Pilcher (152) in an excellent review of this subject. Sir Benjamin Brody in 1828 (20) approved of this policy. Later however cases were reported in which the foreign bodies within the brain substance were removed. In the Medical and Surgical History of the War of the Rebellion (126) 85 cases of bullet removal were reported. Andrews (4) in 1868 and Wharton (214), 10 years later advocated the removal of retained bullets when they were localizable and accessible. Morris (133) in 1887, Papallion (143) in 1894, and Hewitt and Lidell (93) in 1887 held this same view. Phelps (150) in 1906 stated, "There is probably no authenticated case in which the bullet left in the brain substance has failed to work mischief. DaCosta (46) in 1910, wrote "that practically every lodged bullet (in the brain) constitutes a fatal condition and it should be removed if possible, even if there are no symptoms."

Following the use of roentgen rays in visualizing and localizing intracranial foreign bodies, first suggested in 1896 by Stubenbord (152, 184) removal became a more practical procedure, and was more widely practiced. (Rouviellois [163], Cazamian [34], Regard [159] and Villandre [200] recommended removal of all foreign bodies.) As a result it was observed that a relatively small number of retained foreign bodies were discovered in patients with head injuries following their return to the United States after World War I (127). In two series aggregating 392 patients with head injuries at general hospitals, 29 had intracranial foreign bodies which were either pieces of metal or bone fragments. Frazier and Ingham (63) reported our percentage of retained foreign

bodies which is 10% is almost identical with that recorded by Sargent and Holmes 164 in 1567 cases, or 11%. Of a series of 9 patients with retained missiles treated by Bagley (9) 7 were operated upon. Four had an associated abscess with a positive culture. In 3 cases there appeared to be no signs of brain disturbances from the foreign bodies and in these the cultures were negative.

Frazier's (127) indications for the extraction of foreign bodies were as follows. Foreign bodies causing encephalitis or epileptic seizures should be extracted. Those apparently latent should be left alone. This opinion was subscribed to by Bagley (9) Demmer (52) Von Eiselsberg (204) and Coleman (38) Wagstaffe (206) noted that the incidence of epilepsy was slightly higher among those with retained foreign bodies.

INTERIM PERIOD BETWEEN WORLD WARS I AND II

Interest in penetrating cranial wounds slackened after reviews were made of war experiences by World War I authors. The final surgical techniques evolved were considered as satisfactory. The possibilities in neurological surgery revealed by the war focused attention upon civilian neurological problems. A rapidly broadening field resulted in the training of a number of general surgeons into neurological surgeons who became experts in this particular speciality and in due course of time trained others.

There was thus available at the start of World War II a considerable number of trained neurosurgeons as well as a rapid means of training additional men through short courses or by preceptorship. In contrast to World War I, this was a major advantage true in all specialties when medicine mobilized for war.

A second advantage at the start of World War II lay in the improvement in transportation and its means of mass production. Slow and inadequate methods formerly used were replaced by streamlined methods employing a greater number of men, units, and vehicles and the air as a medium for transportation. Expeditious evacuation from the point of injury to hospitals for definitive treatment, recommended early by Tonnies (191) was constantly a foremost consideration although it was subject, at times to insurmountable difficulties. This factor was of major importance in the management of cranial wounds (114).

Research during the interval between the wars had resulted in the introduction of sulfonamide drug therapy in 1936 with evidence of astonishing results in the treatment of infection.

Sulfonamide therapy was observed to be particularly efficacious in the treatment of infections caused by the streptococcus of the beta hemolytic type the Lancefield Group A hemolytic organism, the meningococcus pneumococcus and gonococcus Staphylococcal infections, however were not benefited to the same degree. The mode of action of this drug by bacteriostasis permitted the control of infection of the central nervous system following cranial wounds in a high percentage of cases.

A widening knowledge concerning body chemistry fluid balance anoxia blood replacement the treatment of shock and wound healing added significantly to the effectiveness of the surgical treatment.

The pathophysiological conditions of the brain resulting from trauma were more clearly understood. Many contributions to the literature both of an experimental and clinical nature, had been made during the interval between World Wars I and II.

An important contribution pertaining to the improvement of the technique for the débridement of penetrating wounds was made by Horrax (99) in 1940. He suggested that such wounds be treated by more radical excision with coming of the track of devitalized tissue in place of the catheter suction débridement. This suggestion later put into practice in World War II proved to be a significant aid in treatment.

Under these circumstances, neurosurgeons in general faced the cranial wounds produced in World War II, adequately prepared organized and equipped.

MECHANISM OF INJURY FROM BULLET AND OTHER PENETRATING WOUNDS

Wounds from high velocity bullets and shell fragments are relatively recent experiences in military surgery. It is only during the past 60 years that high velocity bullets have come into use, and only since World War I that high velocity shell fragment wounds have been noted with frequency. Whereas a low velocity weapon may traverse the body mainly with injury to the immediate neighborhood of the track, high velocity missiles cause extensive damage also at a distance from the track in the tissues. It is not uncommon to see organs, bones and other tissues severely damaged at some distance from the bullet passage. Usually blood vessels and nerves are more resistant because of their elasticity and thus they may escape anatomic injury. On the other hand, vessel injury may be seen at a distance from the missile track by "splash" of the blood against the

intima with longitudinal tears. Thrombosis, secondary tear with hemorrhage from necrosis, or aneurysms, may ensue.

The agents of injury especially concerned in this study include bullet and shell fragments, as well as certain tools and utensils used in low velocity penetration of the cranial cavity. In most instances, pointed bullets are seen in military injuries, whereas round nosed missiles are found in civil practice. In practically every instance, bullets used in military practice are jacketed with a core of lead in the center. Jacketed bullets usually retain their shape except at impact with bone at velocities of 2,500 feet per second or more. In civilian practice with soft bullets, it is common to see the missile shattered into many fragments at impact. In rifle injury the muzzle velocity of the bullet may be 2,000 feet per second or more, and the rifling causes the bullet to rotate about its long axis approximately 3,000 times per second with a velocity of 500 or more feet per second. Sir Victor Horsley (104) has attributed the explosive effect of high velocity missiles to the rotation of the bullet about its axis rather than to its muzzle velocity. This will be discussed in greater detail in the next few paragraphs in connection with recent experiments pertinent to the problem.

Shell fragments may have extremely high velocities, and it has been estimated that they may travel from 4,000 to 5,000 feet per second near the site of explosion. They vary in size and shape and they are more likely to become contaminated with clothing, hair and helmet lining which may be introduced into the cranial cavity. Whereas bullets usually cause a neat wound of entrance and possibly also a clean wound of exit, shell fragments may cause large, lacerated wounds of entry. In accordance with the velocity irregular tears or bruises of the struck area may be seen. Frequently the fragments remain in the cranial cavity. It is interesting to note that in certain instances tiny fragments may be dispersed within the cranial cavity. Among this group of cases there may be instances of relatively little brain damage.

Low velocity penetrating wounds of the skull and brain may be produced by knife blade, ice pick, glass, umbrella end and many other tools or every day objects. Ordinarily infection is seldom introduced into the cranial cavity and this may be partly explained by the fact that during the period of thrust dirt particles are held back as the object enters the scalp and skull.

A very important difference between high velocity and low velocity injuries is to be found in

the type of damaged brain about the missile track. With high velocity injury there is palpating at long distances, whereas with low velocity bullet wounds and with stab and similar penetrating wounds, there may be no damage except for the track in the tissue. Wilson (218, 219) states that

the wounding effect depends upon, first, the amount of energy transmitted to the tissues second the velocity of transmission third, the direction of energy and fourth, the density of the tissue." The amount of energy transmitted to the tissues depends mainly upon the velocity of the weapon. Mass times the square of velocity divided by 2 is the formula to calculate the amount of energy. With velocities up to 2,000 feet per second the amount of energy utilized, as evidenced by damage done by the missile, is proportional to the square of the velocity. The time of transmission of energy to the tissues is extremely important and this depends upon the velocity of the injuring object. The shorter the time of transmission, the greater the horse power expended in a unit of time. Callander (30) states that with extremely high velocities the wounding effect of the missile varies as the cube of the velocity and only as a single power of the mass. The density of the tissues is also important. Wilson (218, 219) working with gelatin solutions, concludes that the energy of the missile is dispersed inversely to the square of the percentage density that is in a 5 per cent gelatin solution explosive effects are approximately 4 times as great as in a 10 per cent solution, 9 times as great as in a 15 per cent solution and 16 times as great as in a 20 per cent solution. The velocity imparted to the tissues about the track is important in that bits of tissue, bone fragments, and other organic matter may act as secondary missiles with more extensive injury. If a bone is struck by a high velocity missile near the wound of exit, there may be extensive shattering with skin loss. Ordinarily the elasticity of the skin protects it from extensive tears and lacerations. Whereas a discreet wound of entrance and exit may be seen with a high velocity bullet injury of the thigh, the skinned extremity of the same experimental animal will be shattered to bits by the same missile injury (31).

The palpating effect at a distance from the missile track has been the basis for much experimental work. Sir Victor Horsley (104) attributed this to the 'explosive effect' of the bullet in its passage through the tissue. He thought that the rotational activity of the bullet, rather than the muzzle velocity caused the explosive effect. Recently Black, Burns, and Zuckerman (15, 270)

have shown that when a high velocity pellet with out rotational acceleration enters a gelatin cube it causes a tail splash at the entrance. As the missile traverses the gelatin there is a marked swelling and enlargement of the cube to 4 or more times its previous size. This is caused by the formation of a temporary cavity which almost completely disappears as the pellet passes through and the gelatin cube returns to its former size. Black, Burns and Zuckerman (15 220) emphasized that rotation of the bullet on its long axis in rifle in junes is not the cause of the explosive effect. However they admit that a change in the position of the bullet as it enters the tissues or as it passes through the same because of precession, may alter the dimensions of the track, but the temporary cavitation about the track is due to radial velocity imparted to the walls of the track by the passage of the missile. Butler Puckett Harvey and McMillan (23) have studied the passage of spherical missiles with the use of a microsecond x ray apparatus with which x ray pictures may be taken in one-millionth of a second or less. They have shown that in its passage through the cranial cavity the missile causes a large temporary cavity which expands rapidly and undergoes several pulsations before the tissues return to preinjury dimensions. The passage of the missile causes high radial velocity imparted to the tissues about the track which in turn causes the temporary cavity. Within the cranial cavity this produces an intense increase in intracranial pressure with maceration and pulping of tissue at long distances from the missile track and extensive disorganization of the cranial bones with fragmentation and separation at suture lines. In order to show the role of the intracranial contents in such injuries the following experiments were carried out. A cat, under anesthesia, was struck in the head with a sphere $4/32$ of an inch in diameter with an impact velocity of 3 800 feet per second. There was extensive fracturing of the skull with fragmentation and separation at suture lines. In another cat the skull was cleansed of the soft tissues and brain and a similar injury merely caused a wound of entrance from 6 to 8 times larger than the sphere and a small wound of exit only a little larger than the missile. The comparison of the perforations of the skull in this instance with the extreme fracturing and fragmentation in the experiment in which the intracranial contents were intact is most convincing.

Wounding by shell fragments has been extremely common in World War II. Only 15 per cent or less of the cranial wounds entering the evacuation hospital were from bullets. The great

est majority of the bullet wounds of the head caused death on the field of battle. Shell fragments vary considerably in size shape, and contour. They may travel at extremely high and then again at low velocities. The irregular contour causes extensive laceration and the missile is more prone to carry dirt and foreign matter into the body. The mode of injury is essentially the same as with a high velocity bullet if the fragment is stopped by the body while travelling at a high speed. Severe lacerations of the brain with pulping of the cerebral substance along the track occurs. In many instances penetrating shell fragments remain in the cranial cavity a few may perforate.

In penetrating low velocity wounds such as those caused by knife blade umbrella end or fan blade there may be a tearing of important vascular channels and infection may be introduced into the cranial cavity. The brain about the track of the missile is not pulped and therefore can successfully resist certain amounts and types of infection.

The mechanism of sudden death following penetrating wounds of the brain has been investigated by Polis (156) and Webster and Gurdjian (309). It was observed to be due to a paralysis of the vasomotor and respiratory centers in the medulla. With an increase in the velocity of an injuring bullet, there was a corresponding increase in the severity of the physiological effects.

METHODS OF TREATMENT—WORLD WAR II

Certain generalizations regarding the treatment employed in World War II warrant mention as a preface to the details of operative technique used in high velocity wound management. Among these is the attitude toward patients with cranial wounds. The treatment of this group of patients was undertaken not only from the standpoint of humanitarian obligation for further duty but as a humanitarian obligation. Regardless of the severity of the wound the courage required in the collection of the patient from the point of injury the time employed in primary care, or the efforts consumed in effecting postoperative recovery a conscientious effort was made to accept that responsibility by all personnel involved. This philosophy on the part of surgeons nurses company aid men and hospital corpsmen was a significant factor in the excellence of the care which these patients, in general received.

The campaign in Africa and in Italy early established the value of the neurosurgeon in the Evacuation Hospital and set a pattern which settled any doubt as to where the treatment of

cranial injuries should be carried out, in either a last moving or a stationary type of warfare. Auxiliary surgical teams supplied the personnel for these hospitals if neurosurgeons were not available. Following operation and after a period of observation in the Evacuation Hospital for from 5 to 10 days the neurosurgical patient was evacuated to a "Neurosurgical Center" a general hospital so designated, for late postoperative care and convalescence. General hospitals were deployed as near to major activity as possible, reaching such positions for operation within one month after an invasion.

A second practice of major importance was the modification of neurosurgical operative technique to war wound needs following the suggestion made by Horrax (99) in 1940. The availability of electrocoagulation and efficient suction units resulted in the adoption of more radical measures in débridement. It was also recognized that "brain areas could be wholly or partially removed without detriment to the individual" (99). By the older technique "a careful but necessarily slow and tedious débridement of the wound in the brain was accomplished, an average of two hours being required for the serious, deeply penetrating wounds" (99). By modernizing the technique, operations were performed rapidly with time saving short cuts. Skillful co-operative smooth functioning teamwork usually assisted the surgeon. Ability, experience and confidence acquired in previous training implemented the surgeon's desire to accomplish his purpose as quickly as possible. Laborious attempts at hemostasis were replaced by rapid coagulation. Slow irrigation débridement was replaced with total suction débridement of all devitalized tissue. Modern electrical apparatus provided necessary illumination. From the preparation to the closure of the scalp all but essential manipulations were eliminated.

PRIMARY DÉBRIDEMENT

All cases with scalp wounds were considered as cases of penetrating wounds of the brain unless proved otherwise and all but the obviously fatal wounds were explored (Fig. 2). Following neurological examination, routine roentgen studies of the skull were made. Stereoscopic views were held to be essential by some (31) but the pressure of work or failure of the patient's co-operation often made any additional studies impossible. Visualization of the bone fragments and actual count was attempted. In general, the neurosurgeon was able before operation to visualize the path of the penetrating missile and the degree of bone injury

and imbedding of the bone fragments. Individual surgeons varied in their standards for determining the inoperable patient, but in general, except when the pressure of work was too great, all but the obviously fatal wounds were explored. Particular attention was given to the selection and operation of patients with increased intracerebral bleeding who failed to respond to resuscitation and those with intraventricular wounds (89). Intensive resuscitation measures were employed, consisting mainly of the transfusion of whole blood and plasma, the employment of warmth rest and pain relief and the provision for adequate pulmonary ventilation. Craig (41) has recommended the use of oxygen to help reduce increased intracranial pressure. The high incidence of associated injury (approximately two-thirds of the patients observed by Gaynor and Gurwitz (67)) presented wounds in addition to that of the head) required consideration in planning treatment.

Eden (58) has stated "that there is no doubt that the surgeon who first operates on an open wound makes or mays it—ideally the initial operation should be the final and complete one. The principle of an all or nothing débridement stressed by Cushing (127) was followed in principle although not always attained. The scalp was prepared by complete and thorough shaving and washing about the wound with soap and water for 10 minutes. The use of an antiseptic was elective. Local infiltrative anesthesia was used whenever possible, supplemented by the use of preoperative morphine analgesia. Cairns (14) has objected to the use of morphine, while Horrax (101) believes it may be used in widely open compound wounds. Stemon (178) used local anesthesia in 56 per cent of penetrating brain wounds with a basal narcosis induced by allopoin (gr 35) scopolamine (gr 1/150) and luminal (gr 3). When a general anesthetic was required, the intratracheal administration of ether was preferred. Sodium pentothal has been used with success (129) but caution is required to control the depth of anesthesia (67). Supplementary pentothal anesthesia was used in 25 per cent of the patients operated upon by Munslow (136).

Long curved incisions of the scalp which included the total excision of the wound of entrance were made in place of the 'tripod' type formerly used. They were planned to permit an adequate blood supply to the scalp. The incision was designed with the purpose of securing scalp closure at the end of the operation. The pericranium was carefully removed from the bone defect after débridement since its later use for dural grafting



Fig. 2. Civilian patient presenting a gutter type wound of the right parietal area by a .38-calibre revolver self inflicted. She was operated upon 6 hours after injury. Through curved incisions the area of bone defect was ex-

posed, fragments of bone and pulped brain tissue were removed. The dura was debrided. The dural defect was repaired with a fascia lata graft. The bone defect was subsequently repaired with tantalum.

was possible. The bone defect was enlarged with a rongeur. Frequently a bur opening was necessary, adjacent to the point of entrance. Fragmented bone was removed as well as any additional bone to expose adequately the injured dura and brain. More severe fragmentation of the inner table has often been observed (57). The en bloc method of bone removal was usually not employed. After the excision of damaged dura, the track of the missile in the brain was debrided by suction removal of the devitalized cerebral tissue, blood clot, and bone fragments. A coring of the track to normal tissue was frequently accomplished under direct vision with a lighted retractor as suggested by Horrax (99). The utmost care was employed to spare injury to the cortical vessels. Foreign bodies were extracted if at all possible; the electromagnet being employed by some. Entering the ventricle was avoided but not at the sacrifice of incomplete débridement. Saline solution was used in irrigation of the track and wound although not advised by Munro (8). When doubt existed as to whether all bone fragments were removed, the finger was gently used in the large tracks to feel for the fragments. The dura was closed by means of a graft of pericranium, temporal fascia, fascia lata, or preserved cadaver dura. Cushing silver clips were sometimes used in place of sutures by Havnes (89). In some instances, to conserve time the dura was not closed. Two layer interrupted silk closures were attempted in all cases. Relaxing incisions were not used. In cases of severe scalp loss over a defect of skull and dura, a flap of scalp was used to cover the defect. The bare pericranium was immediately grafted (split thickness). An osteo-

plastic flap has been recommended in the small clean wounds associated with persisting neurological signs for exposing an intracerebral hemorrhage (25). The local instillation of sulfanilamide, penicillin or combinations in the brain track and in the overlying wound was done by some surgeons (26, 58, 171). Cairns (26) stated that in recent brain wounds (up to 72 hours old) penicillin can be applied in a powder (5,000 units of penicillin per gram of sulfanilamide) followed by primary closure of the wound. In 129 cases so treated, fatal infection developed in only 2 cases. He stated also that sulfanilamide and sulfathiazole have been used in some hundreds of brain wounds with no reactions of the kind described by Watt and Alexander (208). Following operation all patients were treated systemically with sulfadiazine or penicillin; the chemotherapy begun at the time of wounding or shortly thereafter being continued. It was discontinued when the wound was healed.

DELAYED PRIMARY DÉBRIDEMENT (24 HOURS—10 DAYS)

The observation first made in World War I that patients with cranial injuries are transportable with greater safety before rather than after operation resulted in a late primary débridement of cranial wounds being done in many instances (7). Unlike patients with delayed wound care in World War I who travelled well but ultimately died of infection, many of these patients survived. Generalized infection was usually prevented by chemotherapy and the localized encephalitis was reduced in degree and even controlled. Thus patients in this class in

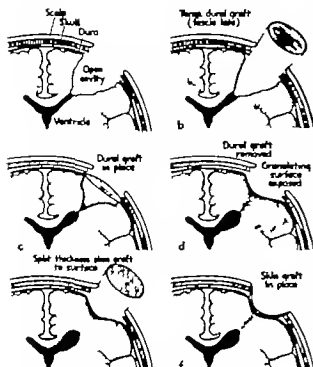


Fig. 3. Open exteriorization method of treating brain abscess with graft of fascia lata in patients with massive loss of scalp, skull, and dura. The abscess is totally debrided; a temporary (fascia lata) graft is sutured to the intact dural edge, which prevents leakage of the cerebrospinal fluid and herniation; the scalp is not closed; penicillin solution is injected through the graft into the cavity. The temporary graft is removed in from 15 to 30 days and a split thickness graft applied to the area; the scalp being conserved for cranioplasty.

general, did not present wounds with an extruding brain and meningitis as formerly.

The surgical management of this type of wound was similar to that described under primary débridement. Success depended upon total wound excision and thorough débridement of the brain track. A dural graft was not used. The local instillation of penicillin for several days post-operatively in conjunction with its systemic use, aided in wound healing. Terian (Rumanian) (188) reported experiences with delayed operations. In 71 per cent of 103 cases, operation was undertaken within 20 days after injury usually on the sixth to eighth day. Eight of the patients died; 6 of these had meningitis at the time of operation. The fatality rate of 183 cases without meningitis was 1:1 per cent. The conclusion was made that "the time interval after wounding is less important in cranio-cerebral injuries than meticulous and specialized care in investigation, operation and after treatment." The dura was not closed in any of these cases and the scalp edges only

were apposed over the wounded brain by a few sutures.

Delayed primary débridement of cranio-cerebral wounds differs from earlier recommendations made at the start of World War II. Hottel (101) stated that after from 24 to 48 hours "the whole wound should be packed widely open under vaselined gauze or rubberized tissue and the resulting fungus allowed to heal by granulation and recede." Schnitz and Bettsdahl (173) also suggested that after 48 hours the penetrating wounds should be treated as a brain abscess with "open drainage."

SECONDARY DÉBRIDEMENT (10-30 DAYS)

Healed wounds presenting retained bone fragments within the brain were frequently encountered [Italy, 13.4% France, 31.9% (210)]. These were usually the result of necessary haste due to lack of time at the primary débridement when the "all or nothing" rule was not followed. By means of roentgen studies the fragments were accurately localized and after evening of the bone defect a conservative secondary track exploration with removal of the bone chips was performed. This policy has been followed by Eden (58) Schwartz (174) Schornstein (171) and Rowe and Turner (165). When necessary a dural graft was applied with safety since the wound was not grossly contaminated as in patients requiring late primary débridement. The scalp was closed. Tonnies (191) reported that all cases which had been provisionally operated on for tangential wounds of the brain showed prolapse, with splinters of bone in the depths of the brain. The prolapse was reduced by repeated lumbar punctures. Under local anesthesia, the opening in the skull was then enlarged; the depths of the wound freed from dead matter, and any remaining splinters of bone exposed and withdrawn. The wound was kept open by a Mikulicz tampon soaked in protosol, to assure the free escape of discharge. It was noticed in the wounds which had not been tampered with at the front that prolapse of the brain had been hindered by the splinters of skull left in place. At both the primary and the secondary débridements, the attempt was made to remove completely all organic material, consisting mainly of bone chips and of the inorganic material when possible.

In general, the management of retained metallic fragments followed the principles set forth by Frazer (137). Some (67-210) have reported that ragged metallic fragments were found to be laden with organic material—tiny bone fragments, hair and helmet lining—and cultures of such

missiles, as well as of bone fragments usually resulted in the growth of pathogenic organisms. Not only the size of the metallic foreign body but the irregularity was of importance. It is reasonable to view the presence of retained shell fragments particularly as a threat to a future inflammatory complication. Such findings usually do not occur when the penetrating missile is a smooth intact bullet.

CONSIDERATION OF BRAIN ABSCESS

The term brain abscess, as used in this article describes a purulent collection or collections within the brain substance which followed track injury produced by a penetrating missile. An incidence of 16 per cent occurred among 206 patients (including German prisoners of war) with penetrating wounds of the dura and brain observed by Webster Schneider and Lofstrom (210). The incidence among American wounded was 14 per cent in Italy and 19 per cent in France (210). Cairns (27) has reported an incidence of abscess formation in 25 per cent of patients in whom wound débridement was incomplete or performed late. A similar proportion was estimated by Rowe and Turner (165). In Ascroft's series (25) 75 of 292 patients developed brain abscesses under his care. Eden (25) however had but 1 case attributed to the fact that cases were received at an earlier stage and before they had been operated on by the general surgeon.

No case of abscess was noted among patients in whom the dura was not penetrated (210). The abscesses occurred early and were associated with wound infections and frequently with hernias or fungi. Usually they were not encapsulated but were localized by reactive inflammatory tissue of a dense quality at the site of the original débridement and also in the track produced by the missile or the bone fragments. Kornean, Ky (114) noted that in 69 per cent of cases brain abscesses "were due to an infection of the wound. In 28 per cent they were cortical and in 53 per cent intracerebral. They occurred 2 or 3 weeks after injury.

Several surgical methods of management have been employed in treating this type of complication (210). The techniques were based primarily upon a complete redébridement of the wound and the abscess by means of excision of all inflammatory tissue and the abscess itself, the latter being removed by suction. The resulting wound was then treated by (1) closure of the scalp, (2) closure of the scalp about a tube for the instillation of penicillin, (3) exteriorization of the cavity (21) and (4) exteriorization with a temporary dural graft (Fig. 3).



Fig. 4. This patient presented a brain abscess associated with a retained bone fragment and an infected wound. Management consisted of excision of the wound and the abscess followed by the daily instillation of penicillin solution through the scalp. Primary healing occurred.

Webster Schneider and Lofstrom (210) concluded that an early abscess following a penetrating wound of the brain must be treated by complete removal and not by drainage without excision (Schulze and Betzendahl [1-3] in 1940 recommended simple open drainage) and further that no single technique was applicable to all situations. There were situations in which it was possible to close tightly the overlying scalp after wound excision and extirpation of the abscess (174). This is a technique similar to that used for late purulent and nonpurulent undébrided wounds which has been successfully practiced with or without the local use of penicillin. Drainage of the abscess followed by the local instillation of penicillin through a small rubber tube placed into the cavity has been employed by Eden and Cairns (25) and Howe and Turner (165). The latter use a technique of complete evacuation of the abscess and the removal of all foreign bodies establishing drainage by use of a Penrose sheath or rubber tissue drain or occasionally a soft rubber

tube. In addition, a Dakin tube is introduced into the depths of the cavity. At this time a mixture of dry penicillin and sulfanilamide is placed in the cavity. In contradistinction to the ordinary practice of leaving the wound entirely unsutured, it has been found feasible, with the aid of chemotherapy, to carry out a nearly complete closure in many cases. Webster Schneider and Lofstrom (210) found it difficult either to aspirate through a small rubber tube or to inject penicillin solution and were obliged to remove the tubes in 48 hours and inject the solution through the scalp (Fig 4).

In a number of instances these methods were not successful, namely when the frontal or mastoid sinuses were involved when the scalp was edematous and necrotic when there was a large scalp defect through loss of tissue when débridement of the abscess was not as complete as desired. A special form of management was then used which was as follows.

After the usual complete redébridement of the wound and excision of the abscess, the remaining cavity was covered temporarily by means of a graft of fascia lata sutured to the débrided dural edge. This temporary graft and the surrounding bone edge were covered with vaseline gauze, the scalp wound being left open. Penicillin solution could be injected daily through the graft into the site of the abscess. At the end of 15 days, the fascial graft was removed and the underlying brain was prepared for a split thickness graft, which was applied from 5 to 7 days later without disturbing the scalp. Any mobilization of the scalp was avoided in consideration of the subsequent cranioplasty which would also complete the scalp closure.

The temporary dural graft of fascia lata served two purposes: first, it prevented cerebral herniation, and second, it prevented cerebrospinal fluid leakage. Following the débridement of an abscess with disturbance of all the barriers to infection meningitis may result or diffuse infection may be present at the time of the attack upon the abscess. In either situation postoperative cerebral swelling, herniation and fungus formation may result if the débrided area of the abscess has been exteriorized without a covering. A pack or drains may be extruded. If the scalp has been closed over such a defect in the dura, there may be extrusion of the brain subcutaneously. The use of a fascial graft as a temporary covering prevents such herniation until the infection is brought under chemotherapeutic control. Leakage of cerebrospinal fluid into the frontal sinuses may also be controlled by the temporary graft, which

is removed when the brain has sealed itself about the line of normal dura. A temporary graft was used as it was held to be unwise to bury a fascial graft in an unclean wound because of the risk of necrosis of the graft and continued wound infection. However, Rowe and Turner (165) have successfully buried fascial grafts in unclean wounds.

Lebedenko (118) reported a mortality of 15 per cent in the treatment of 231 patients with brain abscess, and his notation concerning the technique of operation was that "if the walls of the abscess are intact, the abscess is removed in toto." (David and Ferey [47] found that 24 per cent of 83 patients with fungus died.) Kornevsky (114) reported a fatality rate of 18 per cent in surgically treated cases of brain abscess. Bukulov (Russian) (22) reported that 16.8 per cent of the patients with abscess died when treated at a specialized evacuation hospital. The mortality in Ascroft's cases was 25 per cent (25). Webster Schneider and Lofstrom (210) found that 27 per cent of the patients with abscesses treated by various methods died. The mortality among those treated by the use of a temporary dural graft (mainly frontal sinus wounds) was 18 per cent.

CONSIDERATION OF WOUND INFECTION FUNGUS, MENINGITIS

The occurrence of wound infection was observed to be dependent upon several factors. These included the season of the year and the associated weather conditions, the terrain on which the fighting took place, the mobility of the war, the speed of evacuation, the number, type, and severity of the casualties, the degree of blood loss, and the extent of the replacement. These influences, and probably many more such as the number of dressings and the exposure of the wounds, had a bearing on wound healing. It was of interest to compare the incidence of wound infection in patients in the Italian and French theaters with that in a group of German prisoners of war. A high incidence of wound infection occurred in the latter group when certain known factors included (1) late primary wound débridement and (2) inadequate or incomplete wound débridement. On a rapidly moving front under ideal weather conditions (late summer) the POW patients were treated by the same chemotherapeutic routine as wounded American soldiers. The comparative statistics were as shown in Table II (210).

The comparison warrants the conclusion that the prime factors in preventing infection are early and thorough wound excision. Cairns (27) found

WEBSTER, GURDJIAN PENETRATING CRANIAL WOUNDS

TABLE II—WOUND INFECTIONS

	Italy			France			Cerebral POW		
			Per cent			Per cent			Per cent
	no	total					36	40	65
Wound infection—total cases	17	0	0.8	7	14	50	0	10	68
Wound infection—cases with dural penetration	7	9	14	5	70	0	10	20	34.4
Brain abscess	6	0	3.4	5	19	3.0	—	—	—
Lack of retained bone fragments									

that in fresh cases operated on by neurosurgeons the incidence of postoperative intracranial infection was only 3.7 per cent. Rowe and Turner (1965) have reported that approximately 15 per cent of the head wounds showed some degree of infection. Slemon (1978) found an infection rate of 12.9 per cent. Plans for wound care must be designed to meet the complications arising from delayed and hasty débridements. The average time interval between wounding and operation was 27.6 hours (maximum 5 days—minimum 6 hours) in patients reported by Slemon (1978). The importance of wound infection to late sequelae has been shown by Ascroft (7).

Although fungus of the brain was a frequently encountered condition (210) this complication did not constitute the problem which it appeared to present in World War I. By means of chemotherapy a spreading encephalitis was controllable and fulminating cerebral swelling and extrusion of the cerebral tissue was prevented. The streptococcus organism responsible for rapid and fatal infections in World War I was particularly vulnerable to sulfonamide and penicillin therapy. Cairns (27) reported that the staphylococcus aureus is a frequent wound contaminant proved by the bacteriological examination of wounds during the Sicilian campaign. The Russians (25) found that only 2 of 300 head wounds were due to anaerobic pathogens (Report by a Committee of Soviet Scientists, 1943 [25]).

The principle of closing the dura following primary wound débridement prevented postoperative herniation. Instances of extrusion of the brain with a separated and infected wound were frequently the result of an underlying cerebral abscess. Relief was obtained after excision of the fungus and total débridement of the associated abscess usually pocketed under the extruded mass.

A meningitis which may have been present was usually completely controlled by means of continuously administered penicillin or sulfadiazine therapy. Exception to this occurred when the

invading organism was drug resistant, being then usually of a gram negative type (Friedlander's bacillus). An unsubiding meningeal infection was also found in the presence of a cerebral abscess which sustained it.

On failure of a patient to improve normally following primary débridement with clinical evidence of infection as the cause of the failure, three steps were taken: the chemotherapeutic program was revised to meet the new demands, efforts were directed at proving the presence of an abscess and cultures were made of the cerebrospinal fluid (210).

SULFONAMIDE AND PENICILLIN THERAPY AND BLOOD LOSS REPLACEMENT

Both sulfadiazine and penicillin were used in the treatment of the cases presented by Webster, Schneider and Lofstrom (210). Those patients who were observed in the Italian Theater were in the main treated with sulfadiazine, while those in the French Theater received penicillin. The incidence of wound infection in each series of cases did not vary significantly: being 19.8 per cent and 23.6 per cent respectively. Of the group of patients with cranial wounds complicated by brain abscesses, the first 15 were treated with sulfadiazine (penicillin being used only when sulfadiazine failed to control the infection). The latter 18 were, in general, treated with penicillin. An appraisal of the results (mortality) based upon the type of chemotherapy employed showed that in the group of 15 cases treated with sulfadiazine 4 deaths occurred. Penicillin also failed to control these fatal infections when used after the ineffectiveness of sulfadiazine was apparent. Among the

TABLE III THE RELATION BETWEEN EPILEPSY AND WOUND SEPSIS

	Number of Cases	Number with Fits	Per cent of Fits
Wound healed in 5 days	30	3	10
Wound healed in from 15 to 60 days	50	1	2
Wound unhealed after 60 days	28	10	35.7

18 patients who received penicillin 5 deaths resulted. Three of the 18 patients were given sulfadiazine treatment when the penicillin failed and all presented favorable outcomes. In this limited analysis, an outstanding difference in the effectiveness of these drugs did not seem to exist. Others have observed the superiority of penicillin (89). Slemon (178) observed an incidence of infection of 31.2 per cent in 32 patients treated by the local application of sulfathiazole while the rate decreased to 9.2 per cent in 184 cases treated locally with penicillin and a sulfadiazine drug. In both groups sulfadiazine was used systemically. Pilcher (154) in over 1,000 experiments has studied various aspects of the chemotherapy of intracranial infections. Among many observations, the following are the most significant:

1. Sulfathiazole may produce severe or even fatal convulsions when applied to the brain and should never be used. (Contrary to clinical experience of Cairns [25].)

2. Experimental staphylococcal meningitis was markedly benefited by oral sulfadiazine but not by oral sulfathiazole.

3. "Penicillin when given intravenously was ineffective in staphylococcal meningitis, but when given intrathecally it greatly reduced the mortality rate.

4. Penicillin given intrathecally in normal dogs produced variable degrees of mild irritation and pleocytosis in the cerebrospinal fluid, apparently dependent largely upon the amount of impurity in the preparation of penicillin.

5. "The healing of open cerebral wounds contaminated with staphylococcal organisms has been augmented by the local use of sulfadiazine but was apparently unaffected by local sulfathiazole or local penicillin. (Contrary to clinical observations.)

6. Chemotherapeutic agents given systemically have benefited experimental cerebral abscesses only in so far as associated meningitis, if present was benefited. In other words, our experiences indicate that such drugs probably do not gain access to well-encapsulated infection of the central nervous system.

The use of either drug it appears, is effective only in proportion to the thoroughness with which the source of the infection is irradiated by surgical measures.

Blood replacement must be recognized as an important factor contributing materially to the control of infection and the production of satisfactory wound healing. A lowered hemoglobin and hematocrit were frequently encountered in spite of previous transfusions in forward installa-

tions, particularly in patients with associated injuries. The latter occurred in 36 per cent of one group of patients with cranial wounds (136) and in 28 per cent in another series (27). Upon admission to the general hospital, liberal use was made of whole blood transfusions. Secondary operations were performed after normal levels were established and further replacement was continued as needed. German prisoners were observed to have a secondary anemia greater than that found in the American wounded, and this may have been an added factor related to the common observation that wound healing in the former group was notoriously poor.

SUMMARY AND RESULTS

Comparison of the types and results of treatment in groups of patients with war wounds requires qualification as to the point in evacuation where the observations were made. The highest mortality of cranial wounds occurs on the battle field itself. Little information exists as to the character of these early fatal wounds. The nearer the front line the higher the mortality (25). The casualties who survive wounds for at least 8 hours reach evacuation hospitals, field hospitals, or similar units for definitive surgical treatment. Death serves to process the wounded during the early hours of injury. The greater number of neurosurgeons available in the American army resulted in the performance of operations upon severe and extensive wounds. In other armies the "more hopeful" of the "bad" (178) lesions were operated upon after minor injuries with absent or minimal neurological signs and then the more severe penetrating wounds, in order of their severity were treated. Some observers (24, 130, 138) have pointed out that the purpose in the neurosurgical treatment of cranial wounds of war is not life saving but the prevention of infection in survivors of such wounds. The process of primary debridement, toward that end, which is usually performed in the Evacuation Hospital is none the less associated with a significant mortality. Secondary debridement at a General Hospital, again in survivors, is also attended by an occasional death. Any evaluation must, therefore, be made only in consideration of the corresponding time and place relationships, and the type of cases selected for operation. This is strikingly true in a review of penetrating wounds of the brain in civilian life. In this class, one-half of the patients who are brought to the hospital die within 6 hours of admission.

Information is now available concerning the care of cranial wounds of World War II at Ameri-

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TABLE IV—CRANIAL WOUNDS AND THEIR MORTALITY IN WORLD WAR II

Author	Scalp Wounds	Mortality Per cent	Fracture Dura Intact	Mortality Per cent	Dura Penetration	Mortality Per cent	Infection Dural Penetration Per cent	Death from Infection Per cent
Arcroft (912)					901	5	5	10.8
Eden (913)	85		130	5	207	22	5	3.7
Haynes (945)	130		60	4	243	8		
Calvin (944)					506	16.4	3.7	
Lebedenko (943) (Russian)		65			719	13.5		
Menslow (1945) (40-77% dura penetration)						17		
Gaynor and Gervitz (943) (56-dura penetration 137)					1	3.4		Low
Scharstein (1943)					90	44.8		34.8
Sorgo (943) (German)					7	4.7	0	6.4
Simon (945)								

*Wounds of scalp and skull.

can evacuation hospitals and at British casualty clearing stations or mobile field units. Table IV summarizes reports which have appeared in the recent literature.

The following patients with war wounds considered in this review were observed by Webster Schneider and Lofstrom after reaching a general hospital having in most instances been previously operated upon at evacuation hospitals. Most had survived their injuries and operation for from 5 to 10 days. There were 198 patients with penetration of the dura and brain and 62 with compound fractures in which the dura escaped penetration. Forty German prisoners of war have not been included in the statistics except in the summary of orbitocranial and cerebellar wounds. There were 84 patients with wounds of the scalp requiring neurological observation. The mortality was 6.4 per cent among 260 patients (Italy 146 cases mortality 6.8%; France, 114 cases, mortality 6.1%). The wounds were caused by shell fragments in 75 per cent of the patients and by bullets in 14 per cent. In 11 per cent the cause was unknown. A summary made in several groups and based upon the type of management required in treatment rather than upon the type of pathological damage produced is given as follows.

Wounds of the scalp (84 cases—0 deaths). The patients in this group reached the general hospital usually because of a significant degree of persistent headache which warranted further rest and observation. Wound infection occurred in 15.4 per cent of these patients, which delayed early return to duty. Pneumoencephalograms were taken of 8 patients who presented symptoms and

signs suggesting subdural hemorrhages. None was found. It was not unusual for patients in this group to require neuropsychiatric attention; their complaints being due to psychoneuroses.

Wounds without dural penetration (62 cases—1 death). The dura was inspected at the time of the removal of the depressed bone fragments in all but 11 of this group of patients. Extradural hemorrhages were found in 3, and subdural hemorrhages in 2; 1 of these patients manifested the complication by Jacksonian convulsions. Four patients presented major neurological disability in 3 of these the dura was observed to be normal. One patient died, trephining being done at the time of failure. Autopsy showed that death was due to diffuse intracranial injury. An encephalographic study was made of 1 patient in this group. Trepanation at the site of a linear fracture was not routinely performed, although it was said to be of value by Haynes (89).

Wounds with dural penetration (198 cases—16 deaths).

The management of wounds with varying degrees of dural and underlying cerebral injury followed in general the principles outlined in the operative technique of primary débridement previously considered. Almost routinely a graft of

	Cases	Deaths
1. Wounds with indriven bone fragments	77	3
2. Outer type wounds	21	1
3. Wounds with retained bone fragments plus metal	76	3
4. Ventricular wounds	11	2
5. Penetrating wounds	8	5
6. Venous sinus wounds (included in other groups)		
7. Bursting fractures	5	3

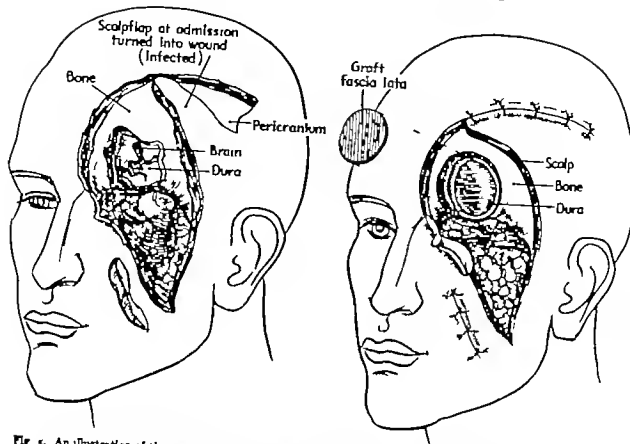


Fig. 5. An illustration of the management of a massive orbitocranial wound by means of a temporary graft of fas-

cia lata followed by a split thickness graft to the defect.

pericranium, temporal fascia or fascia lata was used to close the dural defect when necessary. For example the dura was closed in all but 2 cases of the 50 cases in this group the condition in these 2 cases not permitting further expenditure of time at operation. Among this group of 50 cases, a "preserved" dural graft was employed in 5 patients. The dura was obtained from cadavers and preserved in formalin and then alcohol (177). The observation of "damming back of infection" when closure of the dura was employed, as reported in World War I was not made.

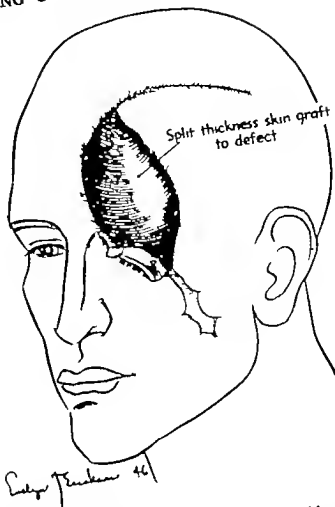
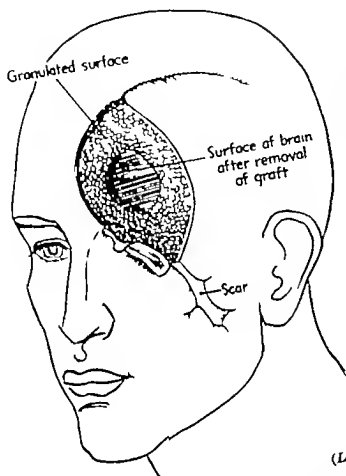
Patients with gutter type wounds almost uniformly sustained massive anatomical damage to the scalp skull, and brain. This type of wound was less commonly observed, probably because of the fact that survivors were less frequent. The observation that the pathway for infection is maximum is supported by the fact that brain abscess developed in 9 patients of this group, an incidence of 43 per cent. The policy of tight closure of all wounds at primary débridement regardless of the degree of infection contrary to that of World War I in which the wound

was left open for free drainage, appears to be well founded. It is of interest that relaxing incisions were not employed in the care of gutter wounds with major loss of scalp. Closure was effected when mobilization of the scalp failed, by means of a flap swung into the craniotomy site, and a bare area of pericranium was left for grafting.

The depth of track damage was usually greater upon penetration by a metallic missile. The potential contamination was also greater because of the fact that fragments, especially those larger than 1 centimeter bore organic material upon their surfaces. This was true particularly of ragged missiles in contrast to smooth bullets. Shell fragments may be covered with tiny bone particles adhering to the surface. The threat of later complications would appear to be considerable when such fragments are retained. A policy of removing all accessible metallic, as well as bone, fragments was followed when such missiles had not been removed at primary operation.

Survivors of wounds involving the ventricles were infrequently encountered. Contrary to the observation in World War I opening of the

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(Legend on opposite page)

ventricle per se in the course of débridement did not significantly increase the mortality probably because of the protection afforded by chemotherapeutic substances. Control of infection was possible, even when the ventricle was entered in the course of debriding a complicating cerebral abscess.

Few patients with perforating wounds survived. The principles in management were similar to those for the less severe penetrating injuries. The wounds of exit, entrance and of the entire track were débrided. The dura was closed by means of grafts if necessary. Only 1 patient was found to survive a perforating injury involving both hemispheres which had been caused by a small shell fragment.

Venous sinus wounds requiring heroic efforts directed at hemostasis ligation muscle grafts and fibrin foam were sometimes encountered. Adequate exposure was of importance. Money (130) believes that the outlook for a return of cerebral function is 'bad' when the sagittal sinus has been completely torn across and requires ligation. We have noted complete neurological recovery in ligations up to the Rolandic

point as has been previously observed by Cush

Orbitocranial wounds (40 cases—5 deaths) The cases placed in this group were limited to those which involved the orbit and the frontal area of the skull and they were considered separately in view of the special type of management often necessitated. The management of this group of wounds has been reviewed in detail (211). The injuries of this type numbered 40 and were divided into two groups—Group I numbering 20 patients who presented severe destructive anatomic injuries to one or both globes in addition to the skull and brain injury. Group II also numbering 20 patients, but these presented wounds which involved the orbit and brain with varying degrees of physiological injury to the contents of the orbit. Massive wounds involving the orbit and frontal area with associated injury to the paranasal sinuses could not be treated by conventional methods of débridement and closure because of the loss of tissue. A suitable method for treating this type of injury was the employment of a temporary graft of fascia lata to close the dural defect. The graft was removed after 15



Fig. 6 Fan blade injury of the right frontal lobe. A 25 gm. intracerebral clot as removed from the missile track. The injury was caused by a broken off blade of an automobile fan connected to a 10 volt circuit and consequently



running at a much higher speed. There was no immediate post-traumatic unconsciousness. About 4 hours after the accident the patient became comatose undoubtedly because of the enlarging blood clot in the missile track (31).

days and a split thickness graft was then applied to the granulating area of involvement (Fig 5). Particular attention was given to the total débridement of the sinuses by removal of all de-vitalized tissue, bone fragments, clots and sinus mucous membrane. Schorstein (171) recommended radical débridement in wounds of the fronto-orbital region and the employment of a soft paraffin gauze pack in the open wound. A plaster-of-paris skull cap was then used as a routine dressing.

Other factors probably include the protected anatomical location of the cerebellum and the adequate covering afforded by the steel helmet which was available in World War II. This type of injury which presents the possibilities of rapid and serious complications, demands exploration as early as possible and is thus a problem for the evacuation hospital neurosurgeon. There was 1 death in this group of patients 8 presented minimal neurological defects.

MILITARY CIVILIAN CORRELATIONS AND CONCLUSIONS

In civilian practice bullet wounds constitute almost all of the high velocity injuries in military experience only 15 per cent of cranio-cerebral injuries were caused by bullets, as seen in a general hospital, and while wounding by shell fragments is unknown in civilian practice 75 per cent of the cranial cerebral wounds in war belonged in this class (310). The majority of bullet wounds in military practice are fatal because of the velocity and size of the missiles. Most bullets for war use are encased in a metallic casing and have a pointed nose. A great many of the civilian bullets are round nosed. Frequent fragmentation and dispersion of fragments through the area of impact are common with the latter. In view of the lower velocities in civilian bullet wounding, is not as marked and therefore there is less pulsing at a distance from the track.

Among the low velocity penetrating wounds of the head are perforation by knife blade, car door handle, golf stick, umbrella end, brick, and various other everyday objects. The management of

An osteoplastic flap used for exposure of the frontal fossa was found to be of value in wounds with penetration produced by small metallic fragments which entered the orbital roof and the frontal lobe at the base of the skull. This exposure allowed débridement at the site of the bony injury and of the brain as well as the repair of the dura either by suture or graft. Distortion of the frontal area through loss of bone was thus avoided. In 5 of the 40 cases in this group brain abscess developed an incidence of 12.5 per cent.

Wounds involving the cerebellum (10 cases—1 death)

It was observed that wounds of the cerebellum were infrequent. Ten cases (an incidence of 3%) were encountered (319). World War I reports indicate so even lower percentage of 54 (6 cases in 1108)—(127). In 9 of the 10 patients the wounds were located on the left side of the cerebellum, and they were caused by shell fragments in all except 3 cases. In 3 instances the wound of entrance was located in the neck and the associated cerebellar injury escaped attention. The infrequency of cerebellar wounds is probably due to a low incidence of survival among patients with wounds involving the posterior portion of the

WEBSTER, GURDJIAN PENETRATING CRANIAL WOUNDS



Fig. 7. Bullet wound of head seen two years after trauma for headaches. Examination showed choked discs and evidences of motor irritation in left lower limb. Suspected cyst about bullet was disproved by air cephalograms. The first operation consisted of decompression and tapping for a possible cyst. Decompression was thought sufficient

but this only cured the complaints. The area of decompression grew to massive size. A second operation was done for removal of the pressure signs. Apparently the bullet behaved like a brain tumor and cure could not be effected without its removal (82)

such wounds deserves only a passing comment. Aside from the possibility of injury to the blood vessels with consequent formation of mass lesions (81) low velocity penetrating wounds of the brain do well under conservative management by careful débridement of the wound of entrance and inspection of the skull and dura. If the fragment is still in the cranial cavity it is removed. Obviously pulped and necrotic tissue is sucked away. No extensive track débridement is necessary but with lacerations of the brain the possibility of intracerebral hemorrhage should be kept in mind. The removal of large clots from the area of the wound may be lifesaving. In Figure 6 are seen the x ray films of the skull of an adolescent youth. A broken-off fan blade is seen in the right frontoparietal region near the midline. Although conscious on admission within 2 hours he became semiconscious and before operation he was comatose. Following the removal of the fan blade a 22 gm. intracerebral clot was evacuated from the missile track. The patient awakened within a few minutes while on the operating table. Usually low velocity penetrating wounds, if seen in the acute stage, do well, but careful observation for complicating meningitis and/or brain abscess is recommended. In the cases in which a penetrating wound of the head with the foreign body still in the brain the fragments should be removed since the possibility of eventual infection about the foreign body is ever present. Dretzka (56) reports an instance of brain abscess about a broken knife blade in the left occipital lobe the

injury having been sustained 10 years previously. The abscess and the broken knife blade were removed and the patient recovered. There is no valid reason that easily accessible foreign bodies should not be removed even if they are asymptomatic.

Penetrating craniocerebral wounds of civilians by bullet and low velocity missiles have been the basis for only a few articles since World War I. The reviews by Hanson (86-87), Pilcher (152), Walker (207) and the articles by Coleman (38), Goode (73), Gurdjian and Buchstein (82) and German Brody and Harvey (69) complete the American list. Goode (73) discusses the cases seen in the Cincinnati General Hospital. Of 105 gunshot wounds of the head, 96 presented dural penetration and a mortality of 80.3 per cent resulted. All of 34 patients with perforating wounds died. In 2 patients retained bullets caused no symptoms for a 10 year period in one and an eight month period in the other. Thirty-one patients were operated upon with a mortality of 45.1 per cent. Goode suggests excision of the wound, of fragments of bone and of the foreign bodies if possible. A fascia lata transplant is recommended for dural repair. Gurdjian and Buchstein (82) reviewed cases of gunshot wounds of the head treated at the Detroit Receiving and Grace Hospitals. Of 45 patients 11 had no fracture of the skull while 34 had fracture of the skull and penetration of the dura or both. Among the group with no fracture 1 had a left parietotemporal subdural hematoma. Of the 34 with fracture of the skull and penetration of the dura or both 16

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Fig. 6. This patient presented a cerebrospinal rhinorrhea associated with meningitis, cortical ulceration, and an intractable wound. Management consisted of secondary débridement with closure of the dura by means of a temporary graft of fascia lata, which was removed later. The open wound was subsequently covered with a split thick skin graft.

died in 9 hours or less and 5 died in 26 hours or less. It was concluded that the state of consciousness is of prognostic significance in this class of patient. These authors group their cases into three classes: first, unconscious and moribund; second, semiconscious and responsive to stimuli; and, third, conscious. In the first group all died within a few hours after entrance into the hospital. The patients in the second group carried on long enough to develop evidences of increased intracranial pressure, hyperthermia, and hyperpnea. An initially low pulse rate was usually followed by a rapid, thready pulse. Five of this group died in 26 hours or less after entrance into the hospital. Among 11 patients who were conscious on entrance 9 recovered and 2 died 1 having received operation. These authors similarly suggest early operation for débridement—removal of bone fragments pulped brain tissue and metallic fragments if possible. German, Brody and Harvey (69) review a group of compound cranio-cerebral injuries. Of 64 patients, 9 had bullet wounds of the head, 6 died, 1 before operation. All traversing wounds terminated fatally.

In the preparation of the present review 100 cases of dural penetration by bullets were reviewed from the records of the Receiving and Grace Hospitals for a period of 20 years. Eighty-three patients died 63 died in less than 12 hours, 9 additional died in 48 hours or less, and the remaining 11 carried on from 3 to 42 days. The prognostic importance of the state of consciousness was again evident. It seems fair to state that among the 11 who survived from 3 to 42 days, timely and total débridement might have saved some lives.

In comparing military and civilian experiences the mortality from bullet wounds of the head in civilian life seems appalling. One reason for this high mortality is that most civilians who survive the immediate injury reach a hospital before death while in military practice comparable cases are seldom seen at an evacuation hospital because of the lack of equally rapid transportation.

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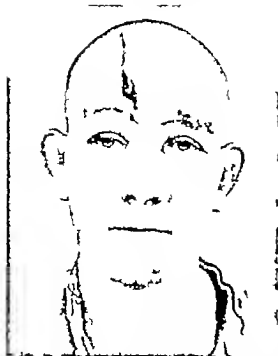


Fig. 8. This patient presented a cerebrospinal rhinorrhea associated with meningitis, cortical ulceration, and an infected wound. Management consisted of secondary débridement with closure of the dura by means of a temporary graft of fascia lata, which was removed later. The open wound was subsequently covered with split thick skin graft.

died in 9 hours or less and 5 died in 26 hours or less. It was concluded that the state of consciousness is of prognostic significance in this class of patient. These authors group their cases into three classes: first, unconscious and moribund; second, semiconscious and responsive to stimuli; and third, conscious. In the first group all died within a few hours after entrance into the hospital. The patients in the second group carried on long enough to develop evidences of increased intracranial pressure, hyperthermia, and hyperpnea. An initially low pulse rate was usually followed by a rapid thready pulse. Five of this group died in 26 hours or less after entrance, 1 patient lingered on for 5 days, and the other recovered. Among 11 patients who were conscious on entrance 9 recovered and 2 died, 1 having refused operation. These authors similarly suggest early operation for débridement—removal of bone fragments, pulped brain tissue, and metallic fragments if possible. German, Brody and Harvey (69) review a group of compound cranio-cerebral injuries. Of 64 patients, 9 had bullet wounds of the head, 6 died, 1 before operation. All traversing wounds terminated fatally.

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ABSTRACTS OF CURRENT LITERATURE

SURGERY OF THE HEAD AND NECK

HEAD

Lubchitz, K. Adamantinomas of the Jaw with Reference Especially to Their Treatment *Acta Radiol., Stockh.* 1945 26 447

Adamantinomas are epithelial tumors which occur chiefly in bones and especially in the jaws the lower jaw being affected more frequently than the upper. Though the tumor is benign histologically it often proves clinically malignant, because of its particular features. It may recur despite repeated surgical intervention and may be responsible for a fatal outcome.

In the jaw at least adamantinomas occur a little more frequently in women than in men. Most often the tumor develops between the ages of 20 and 40 years but it has been found as early as at birth and as late as at the 76th year of age. Its growth is slow and in the beginning it does not give rise to symptoms but as it increases in size it causes the bone in which it is situated to expand. This first interferes with chewing later, deglutition and respiration may become difficult there may be pain and hemorrhages, perhaps spontaneous fracture. Owing to the slow growth however it may often be several years before the symptoms become so marked that the patient finds it necessary to consult a physician.

Morphologically, two forms of adamantinoma may be distinguished solid and polycystic. The former is the rarest. The etiological connection between the adamantinoma and the enamel organ is shown by the similarity of the microscopic structure. Operative removal of the tumor has been practiced ever since its nature was recognized. Both enucleation cauterization, and resection of the portion of bone containing it are mentioned in the literature.

The author gives an account of 11 cases of the disease. The patients were treated at the Radium Center in Copenhagen, during the period from 1932 to 1943. Seven of the patients were males and 4 were females. In 7 patients the tumor was situated in the upper jaw and in 4 the lower jaw. Eight of the tumors were cystic, 3 were solid the latter occurred in the 3 youngest of the patients.

The roentgen examination is an important aid in the diagnosis, which especially in tumors of the lower jaw may often be established with considerable certainty on the basis of the roentgenologic picture. In the film the tumor appears as a well defined rarefaction or as several more or less confluent rarefactions, which often cause expansion of the bone. In the upper jaw the picture is less characteristic, the tumor often (at least in the beginning) shows itself only by a blurring of the maxillary sinus

sometimes by an expansion of the latter and only after some time do also signs of destruction of the bone appear. Only the histological examination, after biopsy or operation, makes the diagnosis absolutely certain.

The author discusses the therapeutic results and stresses the clinical malignancy of the tumors, as contrasted with their histological benignity. She points out that the clinically malignant character of adamantinomas makes complete primary removal important—in the case of solid adamantinomas by enucleation, and in the case of cystic adamantinomas by resection. Roentgen treatment can only be used as a palliative measure.

JOSEPH K. NARAT, M.D.

EYE

Kekchever K. K.: Methods of Accelerating Dark Adaptation and Improving Night Vision *Wor Med., Chic.* 1945 8 209.

The author discusses methods of accelerating the dark adaptation of the eye with the view of improving night vision. Methods include (1) regulating the adaptation before passing into darkness (2) wearing goggles with colored lenses (3) exposing the eyes to white light (4) exposing the eyes to red light and (5) employing gustatory and olfactory stimuli. These methods are not equally valuable. The choice of method used depends on the circumstances at the time of adaptation.

HOWARD H. ROMADKE, M.D.

Hardy L. H., Rand G., and Rittler M. C.: Tests for the Detection and Analysis of Color Blindness: An Evaluation of the Ishihara Test *Arch. Ophth., Chic.* 1945 34 295.

In this article the author and his coworkers evaluate the Ishihara test. They believe that the test is a gross one for defective red and green vision but fails to classify the type of color vision. For this reason it cannot be used to give a satisfactory evaluation no matter how carefully it is administered.

HOWARD H. ROMADKE, M.D.

Shapland, C. D.: Two Cases Showing Unusual Intracocular Foreign Bodies. *Proc. R. Soc. Med. Lond.* 1945 38 663.

In this article the author describes 2 unusual cases of intracocular foreign bodies one of which showed the possibility of the retention of nonmagnetic metallic fragments in the eye for five years with no evidence of inflammatory complications and no evidence of degeneration from chemical action. In the second case the eye retained multiple particles of

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stone without evidence of pyogenic infection. The absence of this infection apparently is due to sterilization of the particles by the heat resulting from the explosion at the time of the accident.

HOMER H. ROWLAND, M.D.

Struble, G. C. and Kreft, A. J.: War Injuries of the Eyes and Visual Pathways. *War Med.*, Chic., 1945 8: 292.

The authors discuss the factors leading to eye injuries in warfare and the type of injuries sustained and illustrate the various forms encountered. They note that serious lesions of the eyes, including macular disturbances, may be caused by blast concussion alone, without any penetrating injury. Penetration of the orbit by minute shrapnel fragments which do not penetrate the globe may also cause serious intraocular damage. No cases of ocular injury following severe war trauma of the mandible were encountered and the authors believe it possible that the temporomandibular joint may absorb some of the concussion. Severe unilateral facial wounds have resulted in damage to the eye of the same side, but never the opposite eye.

All persons who have been exposed to a severe blast or who have incurred war wounds about the head should have a thorough eye examination, especially as to fundi and visual fields. There should also be a complete roentgenological examination of the skull, the facial bones, both orbits and the optic foramina for evidence of fracture or foreign body.

WILLIAM A. MARK, M.D.

DeVoe, A. G.: Surgery of the Anophthalmic Orbit. *Am. J. Ophth.*, 1945, 28: 1346.

An opportunity to see a large number of anophthalmic sockets in military service has resulted in an analysis of some of the difficulties encountered in the use of a properly fitting prosthesis. The commonest use of a properly fitting prosthesis seems to be the retraction or single cosmetic blemish seems to be the retraction or sinking of the upper lid with loss of the normal lid crease. This may be due to a change in the normal direction of pull of the levator, to loss of orbital tissue, to atrophy of the orbital fat, to overlapping of the muscles over an implant with the levator pulled down by the superior rectus, or to use of a large implant, as has been suggested by various authors. It is difficult to overcome this by changing the shape or size of the artificial eye. Attempts to overcome this difficulty have been attempted by (a) severing the attachments of the superior rectus and the levator at the time of enucleation, (b) delayed implantation of a glass sphere, (c) implantation of cartilage on the floor of the orbit, and (d) dermal graft to the upper lid.

The results of the first method are inconclusive. As to the second method, it is often difficult to find a Tenon's capsule for delayed implantation, especially under general anesthesia, and in general this method was found unsatisfactory. If there is a depression of the floor of the orbit, cartilage may be implanted subperiosteally. The author has had

good success with dermal grafts in these cases. Thick skin from the back is implanted high and superficially beneath the skin of the upper lid, using two layers.

The next most common defect is one which usually occurs after an artificial eye has been worn for many years: there is difficulty in retention of the eye due to a relaxation of the orbicularis. An operation similar to Wheeler's method for shortening the orbicularis in spastic entropion may be performed, and the author used this method in 4 cases, with success in 2. In the 2 cases in which this operation was not successful, the defect was corrected by the use of a mucous membrane graft after dissection of the conjunctival surface below the tarsus.

The author believes that the use of skin grafts in the socket should be avoided because of the resulting discharge and odor, especially where both skin and mucous membrane are present.

The surgical procedures described should be used only after all attempts to correct the defect with a properly fitting eye have failed.

WILLIAM A. MARK, M.D.

Reese, A. B.: The Iridodectomy Operation for Glaucoma. *Arch. Ophth.*, Chic., 1945, 34: 356.

Of 61 eyes upon which the author performed an iridodectomy operation for glaucoma, the disease was arrested in 33 and in 9 the results were considered unsatisfactory. Failure in 2 cases was believed to be due to a poorly placed incision. In the remaining 7 the patients had undergone previous trephine operations or had shown uveal pathology and were therefore unsuitable for this method of surgery.

The author emphasizes the importance of making the keratome incision in the sclera 3 mm. behind the limbus, and producing an iridodialysis, leaving both iris pillars incarcerated, which suggests some variation in technique from that which is usually employed. He prefers to incise the conjunctiva with the keratome 10 mm. from the limbus, dragging it down to the point of incision in the sclera rather than to make a clean dissection down to the sclera before inserting the instrument.

It is emphasized as has been brought out by others, that this operation is most useful in cases in which the intraocular tension is not too high—preferably under 50 mm. Hg. (Schlötter). It is not indicated in cases of long standing, in aphasia, or in cases in which previous operations for glaucoma have been unsuccessful.

The author has encountered no serious complications with the operation, and has thus far observed no instance of sympathetic ophthalmia following it.

WILLIAM A. MARK, M.D.

Muldoon, W. E.: Restoration of Patency of the Nasolacrimal Duct. *Am. J. Ophth.*, 1945, 28: 1349.

The author has placed vitallium tubes into the nasolacrimal duct in 4 cases of stenosis of the duct with a fairly good end-result in at least 3 of the cases. The principal advantage of vitallium is its

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lack of tissue reaction the metal may be left in position permanently, and for this reason it has had widespread use, especially in orthopedic surgery. Doherty first reported its use in ophthalmology as an orbital implant.

The author exposed the lacrimal sac by a 13 mm curved skin incision and through a small incision in the sac curetted the nasolacrimal duct and then placed the vitallium tube into the bony canal. The in the shoulder resting on the rim of the canal. The cushion in the sac was closed with 000 plain catgut and the skin and subcutaneous tissues were sutured in the usual manner. A pressure bandage was applied for several days, and the canal irrigated through the upper or lower punctum one or two weeks later.

It was found that in most cases a tube 3 mm in diameter could be inserted without difficulty. Because the metal is extremely hard it must be cast and therefore the walls cannot be less than 0.5 mm in diameter. This inside diameter of 2 mm seems to be adequate for drainage. The length of the tube is 13 mm., which the author believes to be desirable. In one case, a tube 2 mm in diameter was used leaving a lumen of only 1 mm which does not seem to be adequate.

The author points out the advantages of this procedure over a dacryocystorhinostomy and the improvement reported in his cases would seem to justify further use of this method. X-ray films of the tube in position are reproduced.

WILLIAM A. MANN, M.D.

Reis, J. L.: A Corneal Graft Operation for Recurrent Pterygium. *Bril. J. Ophth.* 1945 29 637

The author describes a corneal graft which he uses in association with pterygium operations in order to prevent the postoperative cicatricial opacity with subsequent vascularization which occurs following the general surgical procedure. He believes that the optical and cosmetic results are better and that there is less likelihood of recurrence. The technique is plainly described.

HUNTER H. ROMAN, M.D.

Krause, A. C.: Congenital Cataracts following Rubella in Pregnancy. *Ann. Surg.* 1945, 122 1049.

The author reports 5 cases of congenital cataract which followed rubella in pregnancy, and discusses the preventive, conservative and radical treatment of fetal rubella.

In Australia an unusual number of congenital nuclear bilateral cataracts appeared as a mild epidemic in infants. Damage to the lens evidently occurred during the first few months of pregnancy in mothers who acquired German measles during the second or third month of pregnancy. The cataracts were associated with many other congenital defects. Mental retardation occurred in 4 infants, congenital deaf mutism in 11 and heart lesions in 11.

In a series of 124 cases reported in the literature in which pregnant women were diagnosed as having rubella, 96 infants had cataracts.

In view of the seriousness of the complications therapeutic abortion should be considered if the disease has occurred in the first 4 months of pregnancy. Treatment with convalescent serum should also be considered. Krause stresses the importance of early surgical treatment of the cataract before the ability to develop fixation is lost. This would be before the age of 3 months.

JOSEPH ZUCKERMAN, M.D.

Scholz, R. O.: Epivascular Choroidal Pigment Streaks, Their Pathology and Possible Prognostic Significance. *Bull. Johns Hopkins Hosp.*, 1945 77 345

The author describes 5 cases of epivascular choroidal pigment streaks, rosary streaks of Siegrist, and reviews the literature on this subject.

The majority of the patients considered had hypertensive cardiovascular disease and in some of them renal involvement was indicated. It was possible to follow up the study in 1 instance with autopsy findings. Anatomical reconstruction indicates that the ophthalmoscopic picture is produced by proliferation of the epithelium over partially sclerosed choroidal arteries. It is suggested that the presence of these streaks is of prognostic value, and in the majority of cases a poor prognosis is indicated.

HUNTER H. ROMAN, M.D.

Rodin, F. H.: Hypertensive Retinopathy Associated with Adrenal Medullary Tumor (Pheochromocytoma): A New Clinical Entity. *Arch. Ophth.*, 1945 34 403

Pheochromocytoma is a rare form of chromaffin tumor arising from the embryonic sympathetic nervous system. The adrenal medulla is composed of chromaffin cell tissue hyperplasia of which is considered the rarest form of adrenal tumor. It is characterized by a train of hypertensive changes, including definite ocular changes. Epinephrine or an epinephrinelike pressor substance is contained in the cells of the tumor. This substance freed in the bloodstream causes vasoconstriction, elevation of the blood pressure and stimulation of the sympathetic nervous system. In the eye there is a typical hypertensive retinopathy.

In a case reported by the author there was an extensive retinopathy of a hypertensive type with hemorrhage and exudates. These findings disappeared following removal of the tumor. Serial fundus photographs illustrate the findings in the eyes prior to and after removal of the pheochromocytoma. The author believes that this is a new clinical entity which should be called a hypertensive retinopathy associated with adrenal tumor.

WILLIAM A. MANN, M.D.

Bedell, A. J.: Clinical Differentiation of Emboli in the Retinal Arteries from Endarteritis. *Arch. Ophth.* 1945 34 311

The author describes a means of differentiating emboli in the retinal arterial system from endarteritis.

teritis. In cases of embolism the arteries become mere threads and are greatly reduced in size, whereas in endarteritis the arteries are not as small as those found in embolism. In addition, in the latter case there are always white plaques along the walls of the vessel. In embolism the retinal edema is limited to an oval area which includes the disc and macula while in endarteritis the edema usually involves the entire visible fundus. In cases of endarteritis there is always some evidence of pre-existing arterial disease—increased reflex from the vessels irregularity of vessel caliber indentation of the veins, and exudates, hemorrhages, or other signs of arteriosclerosis and hypertension.

HUTCHER H. ROMADRE, M.D.

EAR

Henry G. A.: Blast Injuries of the Ear. *Laryngeology*, 1945 55 663

In this article are presented the findings and impressions gathered from 592 men sustaining blast ear injuries. These cases were seen during the Battle of Europe at a large hospital part time under canvas and later in buildings. They came chiefly from infantry and armored units.

Tinnitus was the most common and by far the most persistent of the symptoms. It occurred in one ear in 124 patients and in both ears in 48. Usually it lasted for from only a few days to a month, but in a large minority it persisted continuously for from a few months to a year. Vertigo was not a prominent symptom. A few of the men stated that they found blood in their ears shortly after the blast many more found a slight discharge a day or two later. On examination however it was surprising to find how few had evidence of blood in the canal or middle ear. Headache of the usual frontal parietal, or occipital variety was occasionally a complaint, but it did not occur more frequently in this group than in a similar number of soldiers without blast ear injuries. One hundred and fifty two patients suffered perforation of the ear drum, 124 had a single perforation of 1 eardrum, 12 a double perforation of 1 drum and 16 had a single perforation in both tympanic membranes. Hemorrhagic areas of the drum were present in 36 cases. External otitis was present in 1 ear canal in 30 times, and in both ears 22 times.

In the beginning nearly all cases had a combination of conductive and perceptive deafness. The greatest hearing improvement occurred in the first 10 days most of this in the first 4 days. The majority of cases continued to show improvement in perception of hearing a few showed gradual deterioration. It seemed likely to the author that about two-thirds of the men would recover completely. Others would unquestionably be inconvenienced by loss of hearing in one ear and a smaller group would require the help of a hearing aid. Unfortunately a few will have so much loss of hearing that they will require instruction in lip reading.

NOAH D. FABRICANT, M.D.

Struble, G. C.: Penicillin Therapy in the Practice of Otolaryngology. *Arch. Otol.* Chic., 1945 47 317

The parenteral methods used for the administration of penicillin consisted of intravenous drip for the first 24 or 48 hours in the most severe infections, followed by intramuscular injections every 3 hours.

Local methods of application consisted of the instillation of isotonic sodium chloride solution containing 2 500 units of penicillin per 1 c.c. into the sinuses and mastoid cavities the filling of the paranasal sinuses with 1/4 per cent of ephedrin sulfate in isotonic sodium chloride solution containing 500 units of penicillin per cubic centimeter, and the dusting of postoperative mastoid wounds with 100,000 units of penicillin powder.

The following opinions were expressed, supported by illustrative cases. Parenteral penicillin therapy has a favorable effect in acute sinusitis but is not effective after acute and chronic empyema is present. Local therapy shows great promise in the empyema of sinuses. Penicillin therapy is effective in early stages of otitis media, but must be given in adequate doses over a long period.

Suppuration in the mastoid (masked) and came may be incompletely controlled (masked) and cause complications after withdrawal of the drug unless surgical drainage is instituted. Sulfonamide and penicillin therapy should be combined when intracranial extension is suspected.

In chronic otitis media without cholesteatoma or granulations and with a large perforation, penicillin given locally was sometimes useful in controlling local infection.

In cases of superficial cellulitis in deep infections involving the retropharyngeal, submaxillary and parapharyngeal spaces and in Ludwig's angina, penicillin was found to be more effective than sulfonamides in controlling the spread, but almost invariably surgical drainage was also required. Penicillin like sulfonamide compounds, can give an effect masking the presence of disease unless the physician is alert to this possibility. The general principles and indications for surgical drainage remain unchanged.

JOHN R. LUDWIG, M.D.

Lindsay J. R.: Osteomyelitis of the Petrous Pyramid of the Temporal Bone. *Ann. Surg.* 1945 121 600.

Lindsay states that the middle ear air spaces separate the marrow spaces of the bones of the vault from the petrous pyramid and other bones of the base of the skull.

Infection passes readily from marrow spaces to air cells, but extension in the reverse direction meets greater resistance. The cell system, therefore, tends to limit the spread of osteomyelitis between the vault and the base of the skull.

Osteomyelitis of the petrous pyramid sometimes occurs by the hematogenous route or by extension from other bones of the skull base, but it is usually a direct extension from middle ear suppuration.

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The dense labyrinthine capsule forms a barrier between the marrow-containing apex and the middle ear cell system in the majority of bones. In about 80 per cent of bones, however, the air cell system invades the apex and creates a direct entrance for infection and the possibility of osteomyelitis.

A tendency to obstruction of drainage created by a natural bottleneck, predisposes to the breakdown of cell partitions and invasion of surrounding marrow spaces in the apex.

Osteomyelitis tends to remain localized within the apex during the acute stages and responds well to surgical drainage.

Chemotherapy provides a valuable aid in localization but cannot be depended upon to cure without surgical drainage.

In the presence of sequestration or extension of the osteomyelitis to other bones of the base of the skull, the combination of chemotherapy and surgical drainage offers a means of avoiding dangerous complications, but may fail to eradicate the disease.

JAMES C. BRASWELL, M.D.

NOSE AND SINUSES

Lumaden R. B.: War Wounds and Injuries Involving the Paranasal Sinuses. *Edinburgh M. J.*, 1945 55 402

Twenty cases of wounds or injuries involving the paranasal air sinuses are recorded.

In 9 of these the frontal or frontoethmoidal region was involved while involvement of the maxillary or maxilloethmoidal region occurred in 11 cases.

The late operative procedures are described and technical points are discussed.

JOHN F. DELPER, M.D.

MOUTH

Parker D. B.: Observations on the Definitive Treatment of Maxillofacial Injuries. *J. Oral Surg.* 1945 3 320.

In examining and reviewing a large number of maxillofacial gunshot injuries or injuries from contact with high explosive missiles in the military hospitals designated as plastic maxillofacial centers one recognizes certain definite facts. The first observation is in great contrast to the observation of World War I in that the incidence of infection of the soft tissues and bone is much lower. Two or three months after injury we find comparatively few cases of osteomyelitis or necrosis involving the bones of the face and jaws. This is unquestionably the result of early intelligent treatment in the forward areas. The training of medical and dental officers in maxillofacial surgery and the assignment of these officers to teams working with the auxiliary surgical groups have certainly borne fruit in the better control of the wounds when these patients have been evacuated to the United States for intermediate or definitive treatment. The second observation is that there has been a much more intelligent effort to

stabilize the bones of the face and jaws in a more nearly normal, anatomic relationship. This has aided in avoiding the deformities resulting from the collapse of the bony supporting structures of the face often difficult to overcome in the definitive treatment. Wiring techniques have been accepted as an aid in primary treatment in the overseas theaters.

The medical officer has learned that the dentist is essential to the ultimate treatment of the maxillofacial injury just as the dentist realizes that the plastic surgeon is essential to completion of many of the oral operations and the cases as a whole. Mutual understanding as to the part that each should play and a knowledge of the ultimate requirements in function and appearance, have made the plastic maxillofacial services function to the ultimate advantage of the patient.

When there is a loss of bone in the mandible an adequate soft tissue bed in which a bone graft will eventually be placed is essential. An attempt to insert a bone graft in tense adherent cicatricial tissue will often result in failure. Such tissue should be replaced by tissue having a good circulatory bed and loose enough to accommodate a graft without pressure sufficient to alter its contour. Bony support is sufficient to withstand masticatory pressure or to aid in the retention of a prosthetic appliance is desirable before much of the flat surface plastic repair of the face is complete. Bone grafts in areas communicating with the mouth or in which residual infection persists (in the bed or adjoining lost bone) are of course doomed to failure although, with penicillin therapy, some of the implanted bone cells may eventually survive.

One of the most difficult problems attending the definitive treatment of maxillofacial injuries caused by penetrating missiles is the trismus resulting from the wounds adjacent to the coronoid zygomatic temporal area. The marked destruction of the temporal and masseter muscles as well as of the buccal and masseter muscles as well as of the buccal, coronal and masseter muscles in a dense fibrosis in this area, which either limits or obliterates altogether the masticatory function of the mandible. Attention should be given both to preventing the maximum amount of fibrosis and to correcting functional disability.

Another problem in the definitive treatment of maxillofacial injuries is that of adhesion of the buccal mucous membrane to the alveolar ridge of the maxilla or of the maxilla, which obliterates partially or entirely the vestibule of the mouth. Such deformity limits the motion of the lips or of the buccal muscles which results in limited motion of the facial muscles of expression. It also limits the ability of a patient to wear a prosthetic appliance to assist in functional mastication, or for cosmetic use, to improve the contour of the face. Such conditions can be treated only by deep incisions through the adherent cicatrix and the interposition of a split graft over a stent mold held rigidly in position.

LOUIS T. BYARS, M.D.

Cook, T. J. Royster H. P. and Kirby G. K.: The Treatment of Gunshot Fractures of the Mandible. *J. Oral Surg.* 1945, 3 356

Certain essential steps should be followed in the treatment of gunshot fractures of the mandible. Control of hemorrhage, establishment of an adequate airway, temporary immobilization of the fractured bone, and treatment of shock are to be considered first. This is followed by minimal primary excision, without suture except when conditions are favorable for primary closure, and early immobilization of the fractured bone. Secondary minimal excision and debridement are done from 5 to 10 days after the injury accompanied or followed by delayed primary closure of the skin wound. The authors recommend treatment of osteomyelitis by early radical operation. LOUIS T. BYARS, M.D.

McNeely R. G. D.: Adenolymphoma of the Salivary Glands. *Canad. M. Ass. J.* 1946, 54 124.

Five cases of adenolymphoma of the parotid gland are reported. This type of tumor is infrequent, only 3 cases having been found among 155 salivary gland tumors seen in the Toronto General Hospital pathological laboratory in a 10 year period. Only 2 cases of malignancy have been reported in the literature. The tumor becomes apparent as a slow growing mass near the angle of the lower jaw usually in the fifth, sixth, and seventh decade. Subjective symptoms are absent and the growth is encapsulated and easily removed. It is composed of tall, doubly placed acidophilic cells which line the ducts and glandlike arrangements into which may project papillae and which may be dilated to form cystic spaces. The epithelial structures are supported by a lymphoid stroma with active germinal centers.

The genesis of the tumor is discussed and reasons advanced in favor of the hypothesis that it arises from salivary duct epithelium. The lymphoid tissue apparently serves as a supporting stroma and appears to participate in the neoplastic process.

JOHN R. LENTZ, M.D.

NECK

McArthur J. W., Rawson, R. W., and Manna, J. H.: Idiosyncratic Febrile Reactions to Thiouracil: Clinical Characteristics and Possible Pharmacologic Significance. *Ann. Int. M.* 1945 3 915

Thiouracil was employed in the preoperative preparation of 104 patients suffering from thyrotoxicosis. Toxic reactions (applying the term in the most inclusive sense) occurred in 15 instances. In 5 cases fever was the most conspicuous feature of the reaction. The case reports of 3 patients who developed fever are presented, with speculations as to the fundamental significance of the idiosyncratic response.

The sudden onset of fever after a relatively constant latent period of 10 days, the explosive immediate reaction upon readministration of the drug and the character of the accompanying symptoms suggest that thiouracil reactions are manifestations

of the true drug idiosyncrasy. A review of the literature on the nature of thiouracil reactions revealed the fact that attention has been focused on factors which may predispose an individual to develop an idiosyncratic reaction, while the precise chemical factors which render an agent capable of inducing hypersensitiveness have been largely neglected. It is pointed out that the sensitizing capacity of a drug depends upon chemical structure and that hypersensitivity may be developed to the molecule as a whole or to certain radicals of the molecule. Propensity to induce idiosyncratic reactions is strong presumptive evidence of a drug's capacity to become bound to protein. It is suggested that capacity to bind proteins is the common chemical factor which is responsible for the anaphylactoid complications of chemotherapy as well as the therapeutic effect. The prevention of thyroid hormone formation by the sulfonamides and thiouracil may prove to be due to an enzyme blockade mechanism.

JOHN L. LINQVIST, M.D.

Kesting, F. R., and Cook, E. N.: Recognition of Primary Hyperparathyroidism. *J. Am. M. Ass.* 1945 139 904.

Clinical hyperparathyroidism may be divided into three groups, in accordance with the extent of the skeletal involvement. Group 1 comprises the cases with the classic picture of osteitis fibrosa cystica generalisata. Group 2 consists of cases with atypical demineralization of the skeleton, and group 3 includes the cases which showed no skeletal involvement but demonstrated renal calculi. Disease of the bone was demonstrable in 67 per cent of the author's cases. However renal calculi and calcification were found in 93 per cent of the cases. Classic bone disease seemed to be slightly more frequent in women than in men, whereas renal disease was more frequent in men.

Symptoms of hyperparathyroidism were divisible into three groups in accordance with the chemical changes in the blood and urine, or the degree of involvement of the kidneys or of the skeletal system. Chemical changes in the blood were manifested by an increase of calcium and a decrease of inorganic phosphorus. As a result the symptoms were muscular atony, weakness, fatigue and constipation, all of which could be correlated with the degree of hypercalcemia. Polyuria was present in 46 per cent of the cases and was regarded as being due to the excessive excretion of calcium and phosphorus. The latter also provided the basis for nephrocalcinosis. Hyperparathyroidism was suspected in any patient having renal calculi of calcium. Laboratory diagnosis was made on the basis of increased calcium and decreased phosphorus in the serum with a loss of calcium in the urine. Repeated blood determinations were necessary since the elevation of calcium was slight. Thus, in 12 of the 24 cases of hyperparathyroidism the blood calcium averaged less than 12.5 mgm. per cent. Ionic calcium was found to be specifically affected by parathyroid disease while

the organic calcium proteinate was not so influenced. With multiple myeloma or sarcoidosis there was a secondary hypercalcemia mainly in the organic fraction of the blood which accompanied a hyperproteinemia. When the value of serum calcium was equivocal, a low level of inorganic phosphorus, below 3.5 mgm per cent, served as a good diagnostic clue. Elevation of the alkaline phosphatase was useful as an indication only of bone disease but not necessarily of hyperparathyroidism. Under properly controlled dietetic conditions a strongly positive Sulkowitch test for calcinuria was supportive of the diagnosis of hyperparathyroidism. With the Bauer and Aub diet normal persons excreted less than 100 mgm. of calcium whereas hyperparathyroid patients lost between 125 and 200 mgm. per day. In groups 1 and 2 demineralization of the skeleton was manifested by pathological fractures, multiple bone cysts, and milary osteoporosis of the skull. Dental roentgenograms were significant when in conjunction with other bone changes disappearance of the lamina dura of the teeth was found. Examination of renal calculi caused by hyperparathyroidism showed a predominance of calcium oxalate.

In all of the 24 cases a parathyroid adenoma was demonstrated at operation. In no case was a diffuse adenomatosis of all parathyroid tissue found. None of the adenomas in this series was in the mediastinum and none was considered malignant. After operative removal, the blood calcium and inorganic phosphorus returned to normal the former within two days and the latter more slowly. In 50 per cent of the patients tetany ranging from mild to severe, developed postoperatively. Severe tetany seemed to occur most frequently in those cases which exhibited extensive osseous change and high levels of alkaline phosphatase. Mild tetany was accounted for on the basis of a reverse shift in the calcium and

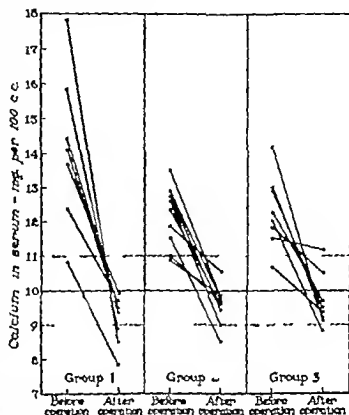


Fig. 1. The changes in the average level of calcium in serum before and after removal of a parathyroid tumor. Each point represents the average of numerous determinations made, in most instances, over a period of several weeks. In 1 case in group 3 no significant change in serum calcium occurred following the operation. The level of inorganic phosphorus and the excretion of calcium were also unchanged, and this has been assumed to indicate that a second tumor is probably present.

phosphorus which created a temporary period of hypoparathyroidism. B G P SHAPIROFF M.D.

SURGERY OF THE NERVOUS SYSTEM

PERIPHERAL NERVES

Sunderland, S.: Traumatic Injuries of Peripheral Nerves; An Analysis of the Incidence in 301 Consecutive Cases of Peripheral Nerve Injuries. *Austral N Zealand J Surg* 1945 15 25.

The author presents a statistical summary of 301 consecutive cases of peripheral nerve injuries observed in military centers in Australia, during the period from 1941 to 1944. The data, summarized mainly in several charts, give the incidence of injury according to the cause ([1] gunshot wounds of war and [2] lesions due to other causes), the location of the injury as to nerve or combinations of nerves, whether the injury was right or left-sided and whether the injury was complicated by bone injury as well. It was found that plexus injuries predominated on the left, that lesions of the ulnar nerve occurred twice as often as those of the median or radial nerves which were involved in approximately equal proportions and that in combined lesions the radial, median and ulnar nerves were affected in equal proportions. In upper limb injuries single nerve lesions outnumbered combined nerve lesions 6 to 1 and upper limb injuries were three times as numerous as those in the leg. Gunshot wounds of the sciatic nerve were nine times as numerous as those due to other causes. In the gunshot injuries lesions of the ulnar nerve predominated also; this nerve was more frequently the common factor in combined lesions than either the radial or median nerve. The commonest cause of peroneal nerve injury was the pressure of a plaster cast.

JOHN MARTIN, M.D.

Sunderland, S.: Blood Supply of the Sciatic Nerve and Its Popliteal Divisions in Man. *Arch. Neurol. Psychiat.*, Chic., 1945 54 283.

The author studied in considerable detail the gross and microscopic characteristics of the vascular patterns of the sciatic nerve in 40 adult human cadavers, with special attention to the gluteal region, the upper middle and distal thirds of the thigh, the popliteal fossa, the neck of the fibula, and the upper middle and distal thirds of the lower portion of the leg. He found that the largest arteries nervorum of the entire body were those supplying the sciatic nerve in the buttock and thigh (Fig. 1). They were arterioles, and they arose from the inferior gluteal artery and the perforating anastomotic chain. Nutrient arteries of the direct type predominated, and these occurred in a T-pattern most commonly when they reached the nerve. The large nutrient vessels were found to enter the nerve directly in most cases, without a long superficial course in the upper sciatic nerve. In the popliteal fossa the largest vessels ran on or within the nerve, but as the common peroneal nerve approached the



Fig. 1. Illustration of a dissection, showing the blood supply to the sciatic nerve from the inferior gluteal artery, crucial anastomosis, and, in particular, the perforating anastomotic chain. The nerve has been displaced medially to demonstrate the latter.

neck of the fibula the larger intraneural vessels were found to occupy a superficial and exposed position in 88 per cent of the specimens, and a deep and protected position between nerve fasciculi in only 12 per cent.

Not only is the peroneal nerve a smaller and less well protected nerve than the tibial, which might partially account for its susceptibility to pressure effects but it is also usually in the form of one major bundle so that its vessels have poor protection from outside pressure. Furthermore the peroneal nerve is poor in supporting and protective adipose tissue. The tibial arteries nervorum have the added protection that they lie in crevices between several bundles of the nerve.

An excellent table is provided to show the source and number of the nutrient arteries to the sciatic nerve in man.

JOHN MARTIN, M.D.

Barnes, R., Bacsich, P., and Wyburn, G. M.: A Histological Study of a Proneurogenic Nerve Autograft. *Brit. J. Surg* 1945 33 130.

For purely investigative purposes, the authors performed an autograft in a patient with a large and irreparable injury to the ulnar nerve. Seven centi-

SURGERY OF THE NERVOUS SYSTEM

meters of the distal segment of the nerve were excised, and were then sutured to the freshened distal end of the proximal segment. The graft was 3 millimeters in diameter and the central segment was 6 millimeters in diameter so that contact of only about 25 per cent was obtained between the stump and the graft. Three fine linen thread sutures were passed through the sheath of the nerve to effect this contact, and the distal end of the graft was then sutured to the intermuscular septum. There was little or no scarring of the soft tissues in the new graft bed. This operation was performed 613 days after the original injury.

After an interval of 168 days the wound was again opened and the graft inspected. There was firm healing at the line of suture and at that point there was a firm fusiform swelling of the nerve. The graft was firmer than at the time of insertion and it was not unduly adherent to the surrounding tissues. The graft was then stimulated with the faradic current (this operation having been done under local anesthesia) but no sensory response was obtained distal to a point 1 cm below the suture line. The entire graft together with 2 cm of the central stump was then removed for histological study.

This autograft was found not to have undergone any central necrosis, and it had provided a pathway for new nerve fibers some of which were found to have proceeded for 20 mm beyond the suture line. None of these new fibers were medullated and the transition from medullated to nonmedullated character took place abruptly and immediately above the suture line. In the opinion of the authors this absence of medullation may have been due to extensive intrafascicular fibrosis which prevented normal maturation of the nerve fibers. While the new nerve fibers in the graft were neither normal in anatomy or quantity it was of significance to the authors that such an old predegenerated autograft could receive nerve fibers after so long a time and that a central stump still could retain regenerative powers as long as 613 days after the original injury.

JOHN MARTIN M.D.

BRAIN AND ITS COVERINGS; CRANIAL NERVES

Murphy J P and Gellhorn E.: Multiplicity of Representation Versus Punctate Localization in the Motor Cortex; An Experimental Investigation. *Arch. New Psychiat. Chic.*, 1945 54 256

This report of an obviously carefully worked out investigation indicates that there is a multiplicity of motor representation in the cerebral cortex rather than the commonly conceived restricted localization of motor function. In the words of the authors emphasis is shifted from isolated cortical representation to more inclusive cortical function.

The animals employed in the study were the rabbit, cat, and monkey these animals being chosen to determine whether or not results of cortical stimu-

lation executed after an original concept of the authors, could be correlated with the principle of progressive encephalization. Such correlation was in fact, possible but to a limited degree, and the broad concept of multiple cortical representation was found to be maintained in this admittedly limited phylogenetic arc.

The authors believe that in stimulating the cortex it should not be subjected to the weakest possible electrical currents but that the aim should be to evoke as much as possible of the total capacity for physiological response. Under such conditions of cortical stimulation they found that multiple representation of movement is widespread in the motor cortex of the rabbit, cat and monkey and that the most common type of multiple representation is that found in the large somatotopic divisions of the leg arm and face. The cortical overlap of two large somatotopic subdivisions apparently decreases with progressive encephalization as the phylogenetic scale is ascended. The point is made that it is movements not muscles which are much more widely represented than the usual cortical maps would indicate. Movements involving distal joints were not found to be more widely distributed than movements involving the proximal joints.

The authors believe that this multiplicity of representation and the extent of representation of movements beyond the bounds ordinarily determined by threshold stimulation probably account for the recovery of function of individual parts of the body after contralateral cortical tissue has supposedly been removed.

JOHN MARTIN M.D.

Oldberg S.: The Significance of Internal Frontal Hyperostosis and Some Related Changes of the Skeleton with Special Reference to Diabetes in the Aged (Ueber die Bedeutung der Hyperostosis frontalis interna und einiger verwandter Skelettveränderungen unter besonderer Berücksichtigung der Verhältnisse bei Altersdiabetes). *Uppsala Lak. Soc. Jark* 1945 51 1

During the last decades the cranial change, which for a long time has been called hyperostosis frontalis interna, has aroused an increasing interest from the clinical as well as from the pathological-anatomical point of view. Under the more comprehensive names "hypophyseal cranial dysplasia" or "metabolic cranio-pathy," a more diffuse thickening of the calvaria is found. While the afore mentioned endocrine origin of local frontal hyperostosis has been generally accepted the genesis of diffuse hyperostosis is less clear and an association between both forms has not been proved. Certain bony changes which have been assigned to the normal increase of age, the so-called senile hyperostosis, have been of great importance in the subject under discussion. The occurrence of the last mentioned change has been considered self-evident for at least 100 years but systematic investigation has not been made.

The clinical significance of the cranial changes is not clear. They have been included together with

adiposity and certain psychoneurological symptoms in the so-called Stewart Morel syndrome and with adiposity and virilism in the Morgagni syndrome. Some authors have emphasized that in case of local frontal hyperostosis a disorder in the carbohydrate metabolism in the diabetic sense may occur. The suggestion has been advanced that by confirming this bone formation an opportunity is afforded for diagnosing pituitary diabetes. The circumstances, however, are not cleared up and no research has been made on a larger scale.

From his x ray studies the author has tried to find out the appearance of the normal calvaria at different ages. The occurrence of the local frontal hyperostosis as well as the general thickness was observed, being directly measured on the x ray plate at certain points. The results thus obtained were taken as a starting point and the same investigation was carried out on material consisting of selected cases of local frontal hyperostosis, acromegaly, hypophyseal adenoma, operatively verified, and also a number of cases of senile diabetes. The author tried to clarify the so-called senile hyperostosis and the hypophyseal genesis of the diffuse thickening of the skull, and, by measuring the sagittal diameter of the atlas, tried to get a clear idea of the relationship of localized changes of the skull to more general disturbances in growth. By means of a comparison between cases with and without frontal hyperostosis and the diffuse thickening of the calvaria, respectively, the author tried to find evidence for the clinical significance of these bone changes. Special interest was taken in the possibility of classifying the cases of so-called senile diabetes in two genetically different forms.

The result of the investigation can be summarized as follows:

1. Signs for the so-called senile hyperostosis are lacking.

2. Hyperostosis frontalis interna appears almost exclusively in female patients, usually first after the menopause, and increases in frequency with age. The endocrine disorder in these patients manifests itself furthermore in a delayed menopause.

3. The general thickness of the calvaria can be attributed directly to a disturbance in growth of hypophyseal origin. It is most pronounced with acromegaly and a little less pronounced with chromophilic hypophyseal adenoma without acromegalic signs, whereas in the case of chromophobic adenoma the thickness is about normal, but still shows some difference.

4. Hyperostosis frontalis interna is positively correlated with a diffuse thickening of the os parietale and consequently with the diffuse thickening of the calvaria. Accordingly it often occurs in cases of acromegaly.

5. In cases of acromegaly as well as of local frontal hyperostosis there is furthermore, an enlargement of the sagittal diameter of the atlas. Thus, there exists an association among hyperostosis frontalis interna, the diffuse thickening of the calvaria and

the enlargement of the atlas, which must be considered as a general growth tendency in the skeleton. The hypophyseal genesis of this bone change is discussed.

6. Hyperostosis frontalis interna and, to a certain extent, the general thickening of the calvaria are in a co-ordinative relation with adiposity, dizziness, and probably with headaches. Therefore, the term "Stewart Morel syndrome" seems to be justified. On the contrary there is no relationship between the above named bone change and hypertrichosis, therefore the term "Morgagni syndrome" seems to be inadequate. The occurrence of dizziness and headaches does not correspond to an increase in the blood pressure. In the diagnosis of adiposity in its different forms the aforementioned bone changes seem to point to a hypophyseal origin.

7. The occurrence of local frontal hyperostosis and to a certain degree even that of the diffuse thickening of the calvaria in women as well as in men, suggests the possibility of an extralobular diabetes of hypophyseal origin when the diabetes presents (a) a benign course not infrequently with spontaneous remission, (b) a slight acidotic tendency and thus an inconsiderable risk of coma, (c) a requirement of insulin only in a few cases, exclusively those of persons who have been ill for several years and (d) a decrease in sensitivity to insulin.

8. The occurrence of hyperfunction of the anterior lobe of the pituitary gland, especially in women after the menopause (formerly chiefly recognized by an increased excretion of gonadotropic hormone) includes even a growth promotive factor and probably also a diabetic one. The practical value of the above mentioned changes of the skeleton as an easily diagnosed clinical sign for hyperpituitarism is emphasized.

Davidson, C. and Demuth, E. L.: Disturbances in Sleep Mechanism: A Clinicopathologic Study. Lesions at the Corticodiencephalic Level. *Arch. V. or Psychiat. Chic.*, 1935 54 232

Discrete lesions of the hypothalamus are known to cause interference with the normal physiological regulation of sleep and all the available clinical evidence indicates that lesions at the corticodiencephalic level not uncommonly produce pathological sleep as well. The authors have had 35 patients with such pathological sleep syndromes. In all, either the cortex or the diencephalon, or both, were involved. Twenty-one patients suffered neoplastic disease, and the 4 other patients had brain abscess, encephalitis lethargica, diffuse syphilitic disease and vascular disease. A strikingly high percentage of the patients showed clearly an extensive change in the hypothalamus. This structure showed compression changes in 16 cases, actual invasion in 4 cases, and gross destruction in 1 case. In 3 patients however the hypothalamus, though compressed did not show any change in the nerve cells. Also, in 16 patients there was in addition to the changes in the hypothalamus, compression or invasion of the basal ganglia with implication of the striohypothalamic pathways. Inas-

much as most of the neoplasms in the series were found to have encroached upon the ventricular system a high incidence (18 patients) of increased intracranial pressure was present in this series.

In a previous article the authors expressed the opinion that some fibers for the control of sleep were believed to originate in the cerebral cortex especially the hippocampal, angular frontal, premotor and temporal convolutions. On the basis of the 25 case histories reviewed in the present article, they postulate that the following structures (both afferent and efferent in nature) are concerned with sleep regulation: the medial forebrain bundle running between the ventromedial olfactory correlation areas of the cortex and the preoptic and hypothalamic areas; the corticohypothalamic fibers via the fornix, the inferior thalamic peduncle and a postulated hypothalamocortical tract. JOHN MARTIN M.D.

Bucy, P. C. Surgical Relief of Tremor at Rest
Ann. Surg., 1945 122 933

A case report is made of a 23 year old male with a diagnosis of unilateral Parkinson's syndrome on the right side following chronic encephalitis the onset of which apparently took place at the age of 5½ years. The patient showed marked unilateral tremor, a weakness of the right lower extremity of slight degree and possibly some weakness of the right upper extremity.

Operation was performed, the central sector of the cortex of the left cerebral hemisphere was exposed up to the midline, with the fissure of Rolando in the middle of the operative field. The cortex did not appear abnormal. All of the exposed cortex was electrically stimulated following which the posterior half of the precentral gyrus was removed over the area which had caused movement (by stimulation) in the right upper and lower extremities. The area was resected subpially down to the bottom of the central sulcus. The great rolandic vein and the communicating vein which crossed the region of extirpation were left intact.

Following operation, the patient had complete paralysis of the right upper extremity and marked weakness of the right lower extremity. There was

gradual improvement in function of the right side without evidence of a return of the tremor.

The last report (9 months after operation) stated that the patient was able to walk with his body upright, rather than with a hemiparetic gait. The tendon reflexes were increased on the right side although this had been true preoperatively. There was no evidence of return of the tremor up to that time.

The area extirpated was the arm and leg portion of area 4 Y and according to the author such extirpation can be expected to abolish tremor at rest in the contralateral upper and lower extremities. The procedure may be expected to produce some increased spasticity and increased perspiration over the right half of the body for a few days. No sensory alterations were noted. HOWARD A. BROWN M.D.

Bailey, P.: Chronic Leptomenigeal Thickening following Treatment of Meningitis with Sulfadiazine. *Ann. Surg.*, 1945 122 917

Four cases of meningitis are reported which were treated with sulfa drugs or penicillin. These cases demonstrated the sequelae which may occur despite the use of these drugs. In all 4 cases the acute purulent infection was controlled but despite this the condition went on to death or a serious sequel because of the fact that the drugs exert no restraining influence on the fibroblasts which proliferate rapidly in an attempt to organize the exudate.

As a result of these changes the leptomeninges become densely scarred and prevent the normal circulation of cerebrospinal fluid. There also may be constriction of the blood vessels as a result of the same pathological process.

The author intends to call attention to the dangers that may arise as a result of these alterations in the nervous system, although early optimism may arise immediately following the administration of these drugs in the treatment of purulent meningitis.

It is not his contention that the drugs should not be used but he states that early diagnosis and intensive therapy with adequate doses before massive exudate has occurred may be of value in preventing these changes and improving the prognosis.

HOWARD A. BROWN M.D.

SURGERY OF THE THORAX

CHEST WALL AND BREAST

Spalding, J. E.: Adenolipoma and Lipoma of the Breast. *Gw's Hosp Rep Lond.* 945 94 80.

The author reports the case of a 56 year old woman who had noted a swelling of the left breast for one year. Since she first noticed the swelling the breast had steadily enlarged. Examination of the breast revealed a lump 8 cm in diameter immediately lateral to the areola. The mass was spherical, well defined and freely movable within the breast. The axillary lymph nodes were not enlarged. The breast was amputated.

The tumor mass was well defined. Microscopically the tumor consisted of fat tissue with islands of epithelium embedded in the fat. In the central part of the tumor there were large islands of epithelial tissue in which alveoli, alveolar ducts and larger ducts could be distinguished.

The author considers this to be not a pure lipoma but rather an adenolipoma. He described a lipomas of the breast that are in the Gordon Museum.

EARL O. LATIMER, M.D.

TRACHEA, LUNGS, AND PLEURA

Clark, D., and Gilmore, J. H.: A Study of 144 Cases with a Positive Coccidioidin Skin Test. *Ann. Int. M.* 1946 24:140.

One or more coccidioidin intracutaneous tests were made on 373 patients, and from 125 with a positive reaction, 100 with residual roentgenographic findings in the lungs were chosen for study, analysis and report. This investigation was made in the pulmonary section of an Army General Hospital serving the southwestern part of the United States in 1942.

The fungus *Coccidioides immitis* is found in arid soil, and has been isolated from wild rodents in central and southern California, Arizona, New Mexico and West Texas. The organism is diphasic, occurring in animal tissue as a spherule from 1-60 microns in diameter with a doubly refractile wall, and multiplying by endosporeulation.

The earliest pathological lesion in man as surmised from studies on animals, is an infectious granuloma following the inhalation of infected dust or, more rarely, entrance through a lesion in the skin. The infection is usually mild, self limited and involves the lungs and associated mediastinal lymph nodes. Antibodies develop in the blood and the lesion disappears or fibrosis leaves a rounded or linear scar and solid immunity. Reinfection does not occur. Exceptionally an abscess may form in the lung or pleura and heal by absorption and fibrosis, or it may break down and discharge organisms through a bronchus which appear in the sputum for months or years without causing sec-

ondary lesions. Rarely chiefly in individuals of the dark skinned races, the infection gains entrance to the blood stream and causes death. In survivors, granulomas appear throughout the body. These tumors may be slowly absorbed or may form chronic abscesses.

The differential diagnosis included tuberculosis, residual pneumonitis fibrosis, healed septic abscess, bronchitis bronchiectasis Boeck's sarcoid and metastatic malignancy. Attention was paid to residence in areas endemic for coccidioides skin tests for coccidioidin and tuberculin, the sedimentation rate, sputum study of the blood for coccidioidin antibodies and roentgenographic examination of the chest.

Fifty-two patients had fever, mild chills, cough, occasional slight hemoptysis, small amounts of mucoid sputum, chest pain, and malaise. Four had skin manifestations. Evaluation of the lungs could not be made without roentgenograms, although pleurisy pleurisy with effusion, and pneumonitis secondary to coccidioidin infection were sometimes found on physical examination.

Coccidioidomycosis mimics tuberculosis however superinfection or the adult type of pulmonary tuberculosis is not characterized by hilar or mediastinal adenopathy. Roentgenographic findings may be grouped under five major types: (1) with pneumonialike infiltrations (2) with tracheobronchial mediastinal or hilar adenopathy or a combination of both (3) discrete nodular type with a round or oval area of increased density from 1 or 3 to 10 mm in diameter occasionally calcified (4) with annular shadows having thick walls and (5) with upper lobe granular or with slightly nodular infiltrations with extension of linear markings into the hilum. As healing takes place initial pneumonialike infiltration is followed in some cases by complete disappearance of the lesion, in others by nodular lesions, by annular lesions, or by strandlike infiltrations.

Many individuals who have been in southwestern United States show a positive reaction to the coccidioidin skin test, and some of these show roentgenographically persistent areas of increased density in the lungs which can be disregarded as a cause of future illness or disability if they are due to an inactive coccidioidin infection but they must be distinguished from tuberculosis and more rarely other potentially dangerous diseases.

A lung lesion absent in previous chest films but present some time after an individual was on the desert is probably due to coccidioidomycosis. Coccidioidin in concentrated form for skin testing in a 1:100 dilution with normal saline solution was obtained from Charles C. Smith of the Department of Public Health, Stanford University.

LYNN JOHNSON, M.D.

SURGERY OF THE THORAX

Camaner A: Cancer of the Lung with Initial Neurological Symptoms (Cáncer de pulmón con síntomas iniciales neurológicos) *Rev As méd. argent.*, 1945 59 1088.

Following a brief discussion of the many syndromes due to pressure on the peripheral and central nervous systems by the growth of the metastases of pulmonary tumors the author notes that in the material at the Hospital Rawson in Buenos Aires the most common form of pulmonary tumor is silent and announces itself as a hemiplegia with a progressive subacute course with localization of the metastases at the level of the internal capsule, in the subcortical area, or in the ascending growth then tends to invade the cortex in this area producing the Bravais-Jacksonian type of epilepsy and later the other structures of the brain particularly the basal nuclei and ventricles and leads to an early death. There is a relatively late appearance of evidence of intracranial pressure, the demise being due rather to the interruption of the vital nerve impulses from the central nuclei.

The article concludes with 4 typical case histories, all in males from 34 to 66 years of age. In each case the hemiplegia was on the left side, progressing rapidly to complete paralysis of the left arm and leg and in no case was any evidence of lung involvement observed until the x rays were used. By this means an original new growth was discovered at the hilus of the right lung in 1 patient, at the right vertex and base respectively, in 2 patients, and at the vertex of the left lung in the last patient.

JOHN W. BARKMAN M D

Strieder J W and Lynch J P Putrid Empyema. *N England J M* 1946 234 1

A better understanding of putrid empyema to be distinguished by surgeons from pyogenic empyema will bring prompt recognition adequate treatment and lowered mortality. An analysis of 90 cases at the Boston City Hospital Boston Massachusetts from June, 1934 to January 1941 and of specific cases subjected to thoracic surgery between January 1938 and January 1941 demonstrates the advantages of early radical surgery.

Putrid empyema a sloughing gangrenous pleuritis, is caused by anaerobic bacteria in symbiosis and characterized by purulent foul, sulfurous or putrid pleural fluid and often gas. From 5 to 10 per cent of 530 cases of empyema treated at the Boston City Hospital in 7 1/2 years were putrid.

Putrid empyema complicated lung abscess gangrenous fusospirochetal pneumonia bronchiectasis tuberculosis with secondarily infected blocked cavities which ruptured into the pleura, pulmonary gangrene distal to obstructing carcinoma, and trauma. The acute stage of all putrid pulmonary infections is believed to be pneumonia.

Gushed from pneumococcal pneumonia was pneumonia. The clinical impression on admission was pneumonia. The physical signs were those of fluid roentgenograms showed consolidation even when fluid

was present. A history of foul sputum was diagnostically helpful. The patients early became toxic and delirious and showed signs of peripheral vascular collapse and the pulse was elevated out of all proportion to the temperature a feature common to all anaerobic infections.

Thoracentesis fluid with a foul odor was pathognomonic. Direct smear revealed fusospirochetes. Anaerobic culture of the pleural fluid demonstrated infection in which symbiosis was involved and related to the antecedent disease. Vincent's angina, periodontal infection, and pyorrhea alveolaris were common in the patients from whom the organisms were aspirated. The infections are referred to as fusospirochetal but anaerobic cocci are associated with them and are of equal importance.

Common to all anaerobes is their inability to live or multiply in an atmosphere rich in oxygen. Consequently open operation with adequate aeration and evacuation of the pus is the treatment of choice. Despite the consistency of the fluid there is prompt stabilization of the mediastinum.

If this is inadequate the pleura is widely incised for about 20 cm. A large prepared dressing is applied and the patient is quickly turned on his back. The dressing becomes saturated and serves as a tampon preventing air exchange while the large wound allows complete drainage. A quick change of dressing is made during expiration the third day. Stabilization occurs from the fifth to the seventh day. A gauze pack impregnated with activated zinc peroxide placed partly in the pleural cavity and partly in the wound controls odor and the wound is clean and granulating in from 5 to 7 days, when the tubes are inserted for convalescent care.

Sulfonamides and arsenicals are of no benefit, but penicillin is a valuable adjunct and effects cures in a certain percentage of cases. Recovery is greatest with early operation. Seventy five per cent of the patients operated upon in the first week recovered. Only 1 patient lived when the disease had persisted 10 days before operation. The surgical treatment generally given for postpneumonic empyema was not adequate for putrid empyema. The mortality under such conditions was 54 per cent. Three deaths among the 21 patients recovering from open resection indicate that a fatal outcome in spite of adequate surgical treatment is usually due to the primary disease. The results obtained demonstrate the benefit of immediate surgery of the open type. The use of activated zinc peroxide packs is specifically helpful.

LYNN JOHNSON M D

HEART AND PERICARDIUM

Blanchi A E., and Rapaport, M: Sarcoma of the Right Auricle (Sarcoma de la aurícula derecha) *Arch. Soc. argent. anal normal B* 1945 6 321

The author describes a primary sarcoma of the right auricle of fusocellular type which formed numerous metastases in the lungs and showed a rapid evolution.

INTERNATIONAL ABSTRACT OF SURGERY

He also collected 34 cases of sarcoma of the right auricle from the literature. Histologically the growths were formed by giant, round or polymorphic cells a few of the growths were fibrosarcomas and fusocellular sarcomas. One was a fibroblastic sarcoma and one a leiomyosarcoma.

In regard to the mode of growth, four types of auricular blastomas may be differentiated: (1) those of an infiltrating character only partially obstructing the auricular cavity (2) those growing exuberantly filling the cardiac cavity and transforming it, as in the authors' patient, into a narrow canal, (3) those affecting chiefly the superior vena cava, and (4) those infiltrating chiefly the myocardium.

Among 35 cases collected from the literature by the authors metastases were found in the lungs in 12 cases in the heart in 10 cases in the mediastinal glands in 7 cases, in the liver in 3 cases and in the pericardium in 3 cases, while the suprarenal glands, inferior vena cava, pancreas and pleura were less frequently the sites of secondary growths. In numerous instances multiple metastases were present, but no metastasis was found in 12 patients.

The authors' patient was a woman 30 years of age who developed dyspnea and an enlargement of the heart 6 months prior to her admission to the hospital. Auscultation failed to reveal any valvular lesions. Gradually an edema of the left upper extremity and of the left side of the chest developed and a considerable enlargement of the liver was noticed. Hemoptysis and edema of the lumbar region and of the lower extremity gradually appeared. No tubercle bacilli were found in the pleural exudate. The fever was of a recurrent type.

The autopsy revealed a sarcoma of the right auricle with metastases in the pleura and the lungs fibroplastic pericarditis and dilatation of the heart.

JOSEPH K. NARAY, M.D.

MISCELLANEOUS

Ratzan, M. C., and Thompson, S. A.: Hypoproteinemia in Surgery of the Thorax. *Am. J. Surg.* 1945 70 213.

Hypoproteinemia in patients with intrathoracic disease is insidious in onset and course, progressive in character and dangerous. Clinically a total protein value of below 5 gm. per cent will find healing markedly impeded. As the percentage is lowered the percentage of fascial planes, herniation, and eversion occur. The cardiorespiratory dysfunction attendant upon a total protein value of below 5 gm. per cent, and an albumin value of below 3.5 gm. per cent will yield a final anasarca.

The balance of protein is obtained through the interplay of 4 factors (1) the exogenous source (food) (2) the synthesis of albumin, globulin, and fibrinogen by the liver after protein breakdown and amino acid splitting (3) loss of protein through increased metabolism and continued inflammation (effusion and empyema) and (4) the excretion, mainly urinary albumin. In thoracic surgery all of these factors are abnormal.

The lowering of the plasma protein in cases requiring thoracic surgery is largely dependent upon the intrapleural condition. It is also moderated by the extent, type and severity of the operative procedure.

The use of blood transfusions, plasma and amino acids by mouth or parenterally must be employed to augment protein intake when excessive postoperative protein depletion is anticipated. The most economical protein replenishment is obtained by the intravenous or intramedullary use of amino acids either the acid hydrolysate with tryptophan or the enzymic digest are suitable for this purpose.

SAMUEL KATZ, M.D.

SURGERY OF THE ABDOMEN

GASTROINTESTINAL TRACT

Fernandes, O: Roentgenological and Clinical Study of Duodenal Stasis (Estado radiológico e clínico das estases duodenais) *Brasil med chirg* 1945 7 355

After presenting a short review of the embryological development of the duodenum, the author offers the following classification of duodenal obstruction.

A. Intrinsic lesions (1) congenital partial or total absence of fixation with abnormal mobility and diverticulum, (2) acquired diverticula, bridges, adhesions, modification of the mucosa hypertrophy of the muscular layers ulcers tumors, and foreign bodies.

B. Extrinsic lesions compression by tumor and compression by a pedicle of the mesentery

C. Functional lesions spastic conditions hypotonia and atony

A mobile first portion of the duodenum may form a fistoon and cause obstruction. In other cases only the portion just above or immediately below Vater's papilla is abnormally mobile and in another variety of mobile duodenum only the third portion is involved. A total mobile duodenum is a rare malformation making up a part of the anomaly called common mesentery.

A diverticulum may be located at the duodenojejunal junction or higher up. Diverticulitis may be the sequel of duodenitis. An acquired diverticulum may form above a stenosis and results from a lack of equilibrium between the duodenal contents and the resistance of the wall.

Bridges, bands and adhesions usually are the result of chronic adhesive peritonitis. Hereditary syphilis tuberculosis, cholelithiasis, and other con-

ditions may produce an inflammatory periduodenitis. Similar processes may follow more distant infectious conditions located in the pelvis or around the appendix.

Intensive duodenitis may spread to the submucosa and cause a hypotonus accompanied by a diminished peristalsis which leads to stasis. Hypertrophy of the valvulae conniventes may also cause stasis. Hypertrophy of the muscular layer may lead to the formation of a veritable sphincter.

Ulcers may be caused by or provoke the occurrence of stasis because of adhesions and cicatricial stenosis. Irritation of the mucosa by violent peristaltic and antiperistaltic motions and trauma of the epithelium in the presence of stasis may cause the formation of an ulcer. Among benign tumors causing stasis the following may be mentioned adenoma fibroma lipoma, myoma, and hemangioma. Such tumors may be sessile or pedunculated. Malignant tumors such as carcinoma, fusocellular sarcoma, myxosarcoma, and melanomasarcoma are rare in this condition.

As to foreign bodies gallstones are the most frequent.

A ptosis of the anterior branch of the vascular mesenteric pedicle may cause a pinching of the third portion of the duodenum. Two arteries may compress the anterior aspect of the duodenum, namely the superior mesenteric and the middle colic arteries.

A chronic duodenal stasis is characterized by the following signs: a rise of nonprotein nitrogen in the blood, an increase of the alkaline reserve, a considerable fall of the blood chlorides, an intensified nitrogen excretion in the urine, a diminution of chlorides in the urine, and hyperpolypeptidemia.

JOSEPH K. NARAT, M.D.



Fig. 1

Fig. 2

Fig. 3

Fig. 1. Defective fixation of the supramesocolic segment. Fig. 2. Stenosis of the duodenojejunal angle. Fig. 3. Total mobile duodenum. Fig. 3. Submesocolic stenosing periduodenitis.

Golden, R., and Ducharme, P.: The Clinical Significance of Deformity of the Cecum in Amebiasis. *Radiology* 1945 45 505

Because several cases were encountered at Presbyterian Hospital, New York City in which the first suggestion that amebiasis was present came from the demonstration of a deformed cecum the authors undertook a review of the records of the 119 cases observed at this hospital in which amebiasis was either proved or thought to be present. In 108 of these cases the endamoeba histolytica was recovered either from stools or tissues. In several of the remaining cases only one stool had been examined.

The cases were grouped into (a) 61 with diarrhea, (b) 15 with abdominal pain without diarrhea, (c) 34 with no significant symptoms directly referable to the intestinal tract, and (d) 9 in which there was inadequate information in regard to abdominal pain. Barium examination was done in 33 of the cases with diarrhea, of which 18 showed a deformed cecum among the 9 cases with abdominal pain a cecal deformity was demonstrated in 3 among the 18 in group c a cecal deformity was found in 4, and among the 7 cases in group d a deformed cecum was discovered in 5. Hence, of the 67 cases subjected to colonic barium study 30 (45%) showed a cecal deformity and this finding occurred 5 times as frequently in cases with diarrhea or abdominal pain as in cases without such symptoms. In 53 of this group of 67 the endamoeba histolytica was demonstrated in the stools and its presence was not disproved in the other 9. Of these 53 cases 41 (36%) showed cecal deformity while another case with deformed cecum and ascending colon terminated in clinical recovery only after a course of emetine. Two other cases of proved amebiasis showed deformity of the transverse colon and a third revealed rectal stricture. Hence approximately 50 per cent of the patients examined and 41 per cent of those with endamoeba histolytica in their stools had definitely abnormal roentgen findings 90 per cent of these deformities were of the cecum. In only 3 cases showing a deformed cecum was there also an associated deformity of the more distal colon but in none of the cases was the terminal ileum narrowed or intrinsically distorted.

In the majority of cases of deformed cecum, the cecal outline was smooth, and in a few irregular. The deformity to be significant, should be persistent in some degree throughout the examination. In 4 of the 5 cases re-examined after therapy for amebiasis some decrease of the deformity was noted but in the fifth case in which shrinkage was extreme no change resulted. The authors believe that at least a portion of the reversible change is due to cecal spasm.

As regards the differential diagnosis the authors point out (1) that in the large majority of cases tuberculosis involves both the cecum and ileum although hyperplastic tuberculosis of the cecum could simulate the deformity described above (2) that regional ileitis commonly involves the ileum

often with resultant narrowing and irregularity of the terminal portion, but it attacks the cecum much less commonly (3) that carcinoma of the cecum usually produces an irregular asymmetrical filling defect often associated with a palpable mass quite different from the usually smooth walled contracted cecum of amebiasis but, of course should a mass be formed by a large amebic granuloma, it could not be distinguished roentgenologically from carcinoma.

The authors conclude that recognizable deformity of the cecum without involvement of the terminal ileum is likely to be present in more than a third of the cases of amebiasis and that this deformity is a clinically valuable sign not diagnostic, but definitely suggestive of the disease. Its absence, on the other hand is of no value in ruling out the disease.

ITALIAN DONALDSON, M.D.

Clute, H. M., and Kenney F. R.: Primary Anastomosis in Carcinoma of the Colon. *England J. M.*, 1945 33 790.

Sixty five cases of carcinoma of the colon are reviewed. The total mortality was 18 per cent (8 deaths) in 34 cases with resection and immediate anastomosis there was a single death, or a mortality of 3 per cent. Eighteen cases requiring Mikulicz resection had a 4 per cent mortality (1 death) Seventeen inoperable cases upon which only palliative procedures could be done had a mortality of 29 per cent (5 deaths) Of the deaths among the resectable cases, 1 was due to shock, 1 to coronary thrombosis and 1 to pulmonary embolism.

These cases evaluate the feasibility of immediate restoration of the intestinal continuity following radical resection of carcinoma of the colon. The authors intended to evaluate the use of chemotherapy in the improvement of their results but became impressed by the numerous factors that had improved colon surgery. They emphasize the value of preoperative and postoperative care. The treatment of anemia and protein deficiencies is accomplished with adequate quantities of blood and the intravenous administration of amino acids before and after surgery. The authors value the use of sulfasuxidine in the preoperative reduction of intestinal flora and because of its mild laxative effect, but note that cases in which it was not used presented equally good results in many instances. They have discontinued the preoperative use of drastic purgatives. Gastric suction is advised for a day before operation and is continued postoperatively until the return of normal peristalsis.

The authors favor radical removal of the tumor and of the lymph glands draining the involved segment of colon. The Mikulicz and other obstructive resections have been relegated to cases in which the risk is poor with partial obstruction or some degree of infection because they can be done quickly and the bowel is simultaneously decompressed. Resection and immediate anastomosis are preferred because of the many advantages to the patient, such as the elimination of spur crushing and of the an

noyances associated with a colostomy. Primary anastomosis has not increased the mortality. The authors did not use many cecostomies but believe that cecostomy is a worthwhile procedure to protect the anastomoses distal to it in the colon and to decompress the obstructed colon which eliminates the necessity of resection for the obstruction.

The article presents the advances made in colonic resection in the last few years, particularly since the introduction of drugs reducing the incidence of infection and the greater knowledge of fluid balance and of total nutrition of the surgical patient.

FREDERICK C. HOBEL, M.D.

LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

With, T. K.: On the Occurrence in Human Serum of Yellow Substances Different from Bilirubin and Carotenoids. *Acta med scand* 1945 132 501

The author has described a method for the quantitative estimation of the nonbilirubin yellow substance in serum by means of the Pulfrich photometer. Investigation of the spectral absorption of pure solutions of bilirubin and solutions of bilirubin in serum were carried out, and it was shown that the proportion between the extinction of the diazo reaction with filter S 61 and that of the spectral absorption of bilirubin with S 43 in the Pulfrich photometer (E 61/E 43) for solutions in serum had a constant value with only little variation from one serum to the other.

The determination of the proportion E 61/E 43 of different sera showed values considerably below the characteristic value for pure bilirubin serum solution for most of them. Consequently the occurrence in human serum of yellow substances different from bilirubin is to be looked upon (by the author) as an established fact. It was also demonstrated that the concentration of these yellow substances in serum was of the same magnitude as the bilirubin concentration. It exceeded the concentration of the serum carotenoids considerably. Further it could be demonstrated that hemoglobin or biliverdin could not be the cause of these findings.

The chemical nature of the nonbilirubin yellow substance and its physiological properties are discussed and the hypothesis is advanced that in human serum it is identical with the xanthorubin of the patetomized dogs and with the pyrrol compounds bilifuscin or mesobilifuscin. DAVID H. LYNN, M.D.

Clagett O. T., and Hawkins, W. J.: Cystic Disease of the Liver. *Ann. Surg.* 1946 123 111

Simple solitary cysts of the liver are localized and usually circumscribed, and occasionally they possess a pedicle. The result is that surgical treatment is far more often possible for solitary cysts than for cystic disease, wherein the lesion is more generalized with reference to the liver.

The authors' patient was a married man 39 years of age. His chief complaints were a feeling of full



Fig. 1. Left lobe of the liver involved by cystic disease; tourniquet applied around its pedicle. Inset: Removal of left lobe of liver and closure of pedicle with interrupted mattress sutures. (Courtesy of J. B. Lippincott Co.)

ness and dull aching in the epigastrium. This distress had been present for 4 years. The symptoms progressed until at the time of his examination at the clinic, he was aware of a large mass in the epigastrium and was unable to ingest even a moderate amount of food without feeling discomfort. In spite of the normal results obtained in investigating the pancreatic function, it was thought that the epigastric tumor was probably a pancreatic cyst.

Accordingly on August 19, 1944, operation was performed through a primary upper left rectus incision. Immediately a portion of the mass containing multiple various sized cysts presented itself into the incision. On further examination it was found that this represented the left lobe of the liver. Examination of the right lobe showed it to be normal in appearance. Palpation of both kidneys was then done and neither seemed to be cystic. By separating numerous adhesions from the mass, a relatively narrow pedicle was encountered adjacent to the ligamentum teres. A Bethune pneumocystomy tourniquet was then applied around the pedicle (Fig. 1) and the entire left lobe of the liver was removed en masse. The remaining stump was closed with interrupted chromic catgut sutures. The tourniquet was then removed and there remained only minor oozing of blood from the stump.

Five grams of sulfanilamide powder were sprinkled into the area and one double iodoform pack was placed to control what oozing might occur from the stump. Two Penrose drains were brought out through the incision. The specimen included the entire left lobe of the liver, consisting of multiple cysts lined by epithelium of the bile duct type. The postoperative convalescence was uneventful.

As far as the authors were able to determine from the literature, this case is the first one reported in

which the entire left lobe of the liver was removed for cystic disease. The only other reported case of a similar nature was that of von Haberer who in 1908 removed the entire left lobe of the liver because of a nonparasitic solitary cyst which occupied the greater part of that lobe.

Most authors agree that the cause of the simple solitary cyst is some form of local obstruction in the biliary tract with a resultant retention type of cyst. In cystic disease however opinion seems to be divided since there are various hypotheses as to its pathogenesis.

All of the articles reviewed make special mention of the fact that cystic disease of the liver is usually associated with cystic disease elsewhere—notably in the kidney. When there are associated renal lesions, they are usually far more advanced than the lesions in the liver.

If a cystic liver has enlarged to the point of causing a palpable mass, the identity of which cannot be proved then exploration of the abdomen is advisable. When such a lesion is encountered two alternatives are possible (1) the involved portion can be removed or (2) nothing should be done. The decision to excise the lesion must be made only after several factors have been considered. The kidneys should be palpated. If they too are involved seriously then there is no point in attempting to excise a portion of the liver; the hazards of this procedure are well recognized.

If the patient has been asymptomatic in spite of the presence of the cystic liver and if removal of the tumor would involve too great a risk, then one would be justified in doing nothing. If on the other hand, the tumor is interfering with the patient's well being, the kidneys are without palpable involvement, and removal of the lesion would not be too hazardous a procedure, then extirpation certainly is justifiable.

Milrizz, P. L.: The Diagnosis of Choledocholithiasis (Diagnóstico de la colédocolitiasis). *Pravda méd. argent.* 1945, 3 9039.

The value of the usual preoperative clinical and laboratory procedures for the detection of stone in the common duct and/or the adjacent hepatic bile passages is admitted, but the author deprecates the fact that they should play more than a modest role in the integral diagnosis of choledocholithiasis. Attempts at preoperative filling of the common bile duct with shadow producing medium by reflux from the duodenum (duodenal catheterization) is mentioned without enthusiasm and as being only rarely successful. Even the nonsurgical cholangiography of Lee of Philadelphia, whereby the gall bladder is injected with a shadow medium through a peritoneoscopy is regarded askance as being essentially a surgical procedure, as being applicable to not more than 50 per cent of the gall bladders, and as being of uncertain innocuity because it leads to biliary peritonitis and other accidents. In fact, all of these procedures pale in significance in face of the inescap-

able duty of the surgeon, not only to arrive at the diagnosis of choledocholithiasis, but also to be certain that the patient has been freed of all the stones in the bile duct. Even laparotomy with direct palpation of the choledochus, choledochotomy with instrumental probing of the bile passages and perhaps the choledochoscopy of McIver are not without objections, and although of aid in determining the presence of canalicular lithiasis in a large proportion of cases, they do not afford an absolute diagnosis.

Operative cholangiography on the other hand has contributed extensively in confirming the diagnosis of stone in the bile tracts. It is a valuable source of information in lithiasis of the ampulla of Vater and intrahepatic stone. It furnishes capital data on the pseudotumoral form of choledocholithiasis, and represents an irreplaceable recourse for providing assurance that all of the concretions have been removed from the principal bile duct. In the case of the calculus located at the ampulla of Vater even when it is too small to show on the film as the usual punch press defect at the lower end of the common bile duct (where the usual outline of the ampulla would be expected) or as the less common defects such as the right angled uniform parrot beaked, festooned and angulated defect appearance, its presence will at times be suspected by the reflux into the duct of Wirsung—which is more persistent than in the cases of simple dystonia of the sphincter of Oddi.

This question of persistence, however, also brings up the matter of the functional criterion in the roentgenological examination of these patients, that is, the taking of one or more cholangiographic exposures following the original one. For instance, in 1 patient of the author's material, the first film disclosed a typical inflammation of the sphincter of Oddi with the usual "Havana cigar" tip to the ampulla; another film was taken and this proffered the classical image of calculus of the papilla (punch press defect) with injection of the duct of Wirsung. In another the first exposure depicted a punch press defect, while the subsequent film showed the condition to be normal. Of course, the taking of two, or of several films at varying intervals is not of itself sufficient to solve all the problems in stone in the bile ducts; frequently all attainable facts will have to be marshaled to arrive at a correct diagnosis.

In 1 patient a history of persistent icterus caused the author to explore the nonfilling left hepatic duct where, in spite of the fact that hepatic duct stones are nearly always multiple, and primary stone in the hepatic duct without accompanying involvement of the common duct is a great curiosity, a single large stone, the shape of a Winchester bullet with nose pointing downward was extracted from the hepatic duct. After this the hepatic system filled normally with shadow medium. At operation in this case the choledochus was found to fill and empty into the duodenum in an unobstructed manner.

However stone is not the only condition preventing the filling of part of the bile tract during the

operative cholangiographic examination. It may be necessary in addition to injecting the shadow mixture through the gall bladder or the stump of the cystic duct, to open the choledochus itself and make an injection through the choledochotomy opening. Or it may even be necessary to provide the injecting syringe with a filiform catheter and push this into the different sections of the bile tract system. This is likely to be necessary in the dilated and distorted passages of the longstanding recurring case of gallstones.

Even if all methods have been exhausted without an explanation of a longstanding clinical history of mechanical icterus, one is still justified in suspecting an obstruction below any of those uncovered: a concretions in the ampulla of Vater, a stenosing pancreatitis or inflammation of the sphincter of Oddi. In any case the ampullar stone is the more probable, and one is justified in resorting to a transduodenal papillotomy.

One of the most difficult problems is the differentiation between the obstruction due to stone accompanied by a pseudotumor that is the matting together by adhesions of the epiploon, colon, gastric antrum and pylorus, pancreas and bile sac, and a true neoplasm. Here again however the author holds that operative cholangiography will be of assistance, in that in the obstruction by stone the injected shadow material surrounds the concretion and reveals the lacunar characteristics of this form of obstructing body, while in the neoplastic type of block the hindrance to the flow of iodine-acetate will be complete.

JOHN W. BRENNAN, M.D.

Robertson H. E.: Silent Gallstones. *Gastroenterol.* 67: 1945 5 345

The author gives a very comprehensive historical review of the literature concerning gall stones. He surveyed the results of postmortem studies of the gall bladder made at the Mayo Clinic during the 10 years from 1934 to 1943 on persons over 20 years of age. A total of 1,027 had gall stones: 497 males and 530 females. In this study no attempt was made to determine the percentage of patients who at postmortem did not have, and apparently never had gall stones. The author with a coauthor found that of 16,036 postmortem examinations at the same clinic in the years from 1910 to 1942, 16.3 per cent (12.6 per cent in males and 22.6 per cent in females) revealed that the person had or had had gall stones. In the present review the histories of these patients were carefully reviewed and it was found that in 626 (61%) there apparently had been no suspicion by the patients or their attending physicians that gall stones had been present. The remaining 400 cases could be fitted into various and sometimes overlapping categories: for example, 305 of the patients had undergone one or more operations for gall stones while in 80 cases stones were discovered accidentally at laparotomy for some other condition.

The assertion by some physicians that a certain percentage of silent gall stones in any given series

is a reflection on the diagnostic abilities of the attending physicians is unwarranted. After gall stones have been accidentally discovered the attribution of the symptoms and signs to their presence is not always on a sound clinical or pathological basis. About 50 per cent of gall stone cases remain unrecognized. Not all gall stones discovered during life warrant operation for their removal; they are an individual problem in each instance and are usually accorded that importance which the best welfare of the patient warrants.

EARL O. LATIMER, M.D.

Skelton, M. O. and Tovey G. H.: Congenital Obliteration of the Bile Ducts and Icterus Gravis Neonatorum. *Brit. M. J.*, 1945 2 914

The authors state that icterus gravis neonatorum and congenital obliteration of the bile ducts may both be associated with biliary obstruction. In the former condition the canaliculi may be plugged by bile thrombi probably as the result of damage of the hepatic cells. Once these thrombi have formed they may aggregate to produce an obstructing mass in the extrahepatic bile ducts, the final effect being to add an obstructive element to the jaundice caused by the hemolysis. Occasionally the biliary epithelial cells become swollen and this tends to aggravate the condition. Desquamated epithelial debris lying free in the lumen of the bile ducts may add further to the obstruction. In some cases of icterus gravis of long standing biliary stasis may occur and produce a picture of hepatic cirrhosis which is very similar to that of congenital obliteration.

Two cases of icterus gravis are described, in which obstruction was believed to have been due to blocking of the large bile ducts with inspissated bile. In one case the plug was dislodged at operation. The fathers of both patients as well as the patients themselves were rhesus positive. The mothers were rhesus negative with Rh antibodies in their blood.

The authors describe 2 other cases of congenital fibrosis of the bile ducts, in both of which there was a rhesus incompatibility demonstrated in the parents. Two siblings of one of these parents bore subsequently died of jaundice. The findings at autopsy included erythroblastosis and kernicterus in both cases.

It is not suggested that all cases of congenital obstruction of the bile ducts are associated with erythroblastosis fetalis, but the fact that some of them appear to be associated with icterus gravis neonatorum is of practical importance. Consequently any family showing a history of congenital obliteration should be examined for evidence of rhesus incompatibility. Only in this way can preparations be made to anticipate hemolytic disease which may occur in subsequent children.

As a prophylactic measure in patients with icterus gravis, the practice of massage over the region of the gall bladder is recommended in the hope of avoiding plugging of the bile ducts and hence obstructive jaundice.

THEODORE B. MARSHALL, M.D.

Smith H. G., Pratt Thomas, H. R., and Mace, L. M.: Re-Establishment of Pancreatic Secretion Into the Intestine after Division of the Pancreas; An Experimental Study. *Arch Surg* 1945 51: 164.

As a result of progress in the radical operative treatment of carcinoma involving the head of the pancreas and the peripancreatic region, pancreatic cancer can be approached today with a clearer concept of the operative technique and with a reasonable chance of accomplishing a surgical cure.

Despite widening experience with this difficult surgical problem, the incidence of postoperative complications remains high. Some of the more distressing postoperative sequelae are referable to the stump of the divided pancreas and consist of external pancreatic fistula, acute pancreatic necrosis, retention cyst, and chemical or "enzymatic" peritonitis. The pancreatic stump has been handled generally speaking by one of two methods: occlusion by inversion of the sutures with or without ligation of the duct of Wirsung; and some form of pancreaticoenterostomy in which the stump is implanted into a segment of intestine. As regards the first method, digestion of the inverting sutures occurs all too frequently with resulting leakage of the pancreatic juice and the consequent development of one or more of the complications mentioned. As to the second method, the question has been raised whether reimplantation of the pancreatic duct into the gastrointestinal tract is necessary inasmuch as it is well established that many patients live normal, healthy lives after being deprived of the external secretions of the pancreas. On the other hand, many such patients suffer severely from disturbances of fat digestion in the form of steatorrhea and malnutrition so that it is important, whenever possible to maintain the external secretory function of the pancreas. An evaluation of techniques of pancreaticoenterostomy employed by various investigators directs attention to two important factors: all procedures (with the exception of Cattell's simple method) involve an open anastomosis, with a consequent breach in asepsis and most of them are too time consuming. This experimental study was conducted in order to develop an aseptic technique which can be performed with minimal loss of time and preservation of the external pancreatic secretions.

Experiments were done on 33 dogs. In 15 animals the pancreas was divided at the junction of the uncinate process and the body without disturbing the relationships of the latter to the duodenum and thereby leaving the junction of the main pancreatic duct intact. The exposed transected surface of the pancreatic body was closed with sutures after ligation of the duct. In this manner the uncinate process was isolated entirely from the remainder of the gland, and its independent blood supply was maintained. The divided end of the duct in the uncinate process was allowed to retract into the parenchyma of the gland without its being ligated. The stump of the divided uncinate process was then implanted

into the jejunal wall in an incision that extended down to, but not through, the jejunal mucosa, and was made secure in the jejunal wall by fine sutures. The remaining 7 animals were operated on by a modification of the technique of Cattell. The procedure was similar in detail to that described, except that the uncinate duct was dissected free so as to protrude from the divided stump of the gland. A crushing ligature of fine surgical gut was tied about the protruding duct and one end of the ligature was passed as a suture through the exposed jejunal submucosa and tied firmly to the other end which brought the duct against the mucosa in a firm necrotizing ligature. The pancreatic stump was secured into the jejunal wall in the usual manner. All animals survived and remained in good condition. Observations of the state of the pancreaticoenterostomy were made at intervals varying from 7 to 48 days by the following technique.

The abdomen of each dog was reopened under anesthesia and the jejunum adjacent to the pancreatic attachment was opened widely which exposed to inspection the jejunal mucosa at the site of the pancreatic implantation. A concentrated, highly active preparation of secretin was then injected into the vena cava. If a fistula had developed from the uncinate stump into the jejunum, pancreatic juice could be seen grossly dripping from the fistular orifice in the mucosa. If fistula formation had not occurred, no response to the secretin was noted. The potency of the secretin was tested by opening the duodenum and observing simultaneously the flow of bile and pancreatic juice from the ampulla of Vater. Of the 33 animals studied, 15 showed definite secretion of pancreatic juice at the pancreaticojejunal junction after the intravenous injection of secretin.

After the functional status of the pancreaticojejunal junction had been determined, the entire uncinate process and the attached jejunum were excised for microscopic study with particular reference to acute pancreatitis, pancreatic fibrosis, and the development of pancreaticojejunal fistulae. None of the animals showed gross evidence of active peritonitis or fat necrosis. There was some evidence of acute pancreatitis in 37 per cent of the animals but pronounced diffuse pancreatitis was found in only 3 animals. Each of these animals appeared to be quite healthy. Some degree of scar tissue formation was demonstrable in 91 per cent of the animals but fibrosis was considered pronounced in only 1 animal. This animal presented an indurated and atrophic stump but no microscopic evidence of fistula. Despite these findings, the response to secretin was positive although the flow of pancreatic juice was sluggish. Definite microscopic evidence of a junction between the mucosa of the uncinate duct and the mucosa of the jejunum was detectable in 59 per cent of the animals. It is pointed out that a fistula may exist despite failure to demonstrate it microscopically by the secretin test and also by the injection of water through the

uncinate duct into the jejunum. No external pancreatic fistula was encountered and only 1 retention cyst which complicated the procedure was found.

JOHN L. LUNDQVIST, M.D.

Varco, R. L.: A Method of Implanting the Pancreatic Duct into the Jejunum in the Whipple Operation for Carcinoma of the Pancreas. *Surgery* 1945 18: 569.

The author presents a technique for anastomosing the pancreatic duct to the bowel in cases of resection

of the head of the pancreas. This procedure has now been successfully carried out in 4 patients.

The pancreatic duct is isolated with a short extra glandular section preserved when the gland is transected. Two fine silk sutures are placed in the wall of the duct to hold it open. A two-holed catheter somewhat larger than the duct is selected—about a size 12. Eight centimeters of the catheter are stretched over a Keith skin needle which serves as an obturator and impaled at a point on the catheter wall slightly eccentric to the tip. As the segment of

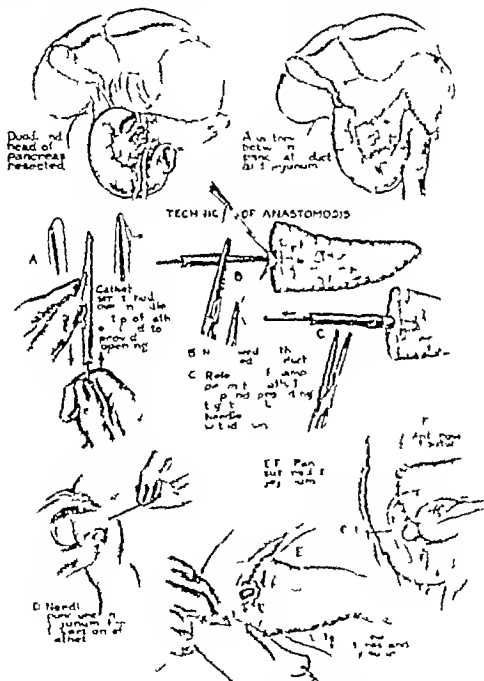


Fig. 1. The two drawings at the top indicate approximations of the results in 1 and 2 by malignancy and diagram the visceral configuration in 3. The anastomosis is shown in 4. The diagram of the operative procedure is shown in 5. The technique of implanting the pancreatic duct into the jejunum is shown in sketches A to F.

catheter is stretched over the obturator its transverse diameter is decreased. It is held stretched by clamping the tube and obturator firmly with a hemostat. An oblique section is now cut from the tube, care being taken to place this distal to the tented wall of the catheter. The stretched catheter is slipped a short distance into the pancreatic duct and on release of the hemostat the catheter is permitted to resume its normal diameter and it is snugly held in the duct. A fine ligature may if desired be used to hold the extraglandular duct against the catheter, but usually this is unnecessary.

With fine sutures the posterior capsule of the pancreas is sutured to the jejunum at the site selected for anastomosis. A fine puncture hole is made with a Keith needle through all layers of the bowel wall and the catheter is forced through this small puncture wound into the lumen of the bowel, which gives a very close fit. Two fine sutures are placed between the connective tissue adjacent to the duct and the serosa next to the puncture site. The remainder of the capsule of the pancreas is sutured to the bowel serosa, namely the anterior aspect.

In 4 cases in which this method has been used there has been no pancreatic fistula.

EARL O. LAMMIE, M.D.

Wakim, K. G., and Mason, J. W.: The Effects of Adrenalin and Nembutal Anesthesia on Blood Constituents Before and After Splenectomy. *J Lab Clin M* 1946, 31, 8.

The authors studied the effect of adrenaline and of nembutal anesthesia on the concentration of hemoglobin and plasma proteins and on the red and white blood cell counts in intact and splenectomized dogs. The lateral surface area of the spleen was determined under nembutal anesthesia before and after the administration of adrenaline.

They found that the intravenous administration of adrenaline increases the concentration of hemoglobin and the red cell count in the circulating blood to a much greater extent in intact than in splenectomized dogs. Nembutal anesthesia causes hemodilution with a reduction in the hemoglobin concentration and in the red cell count, and a slight reduction in the plasma protein concentration. The size of the spleen in dogs under nembutal anesthesia was decreased about 66 per cent by the intravenous administration of adrenaline. The blood squeezed out by the spleen during its contraction under the influence of adrenaline had an average hemoglobin concentration about 11 per cent higher than that of jugular blood.

EARL O. LAMMIE, M.D.

MISCELLANEOUS

Bradford, B., Jr., Battle, L. H., Jr. and Pasachoff, S. S.: Abdominal Surgery in an Evacuation Hospital. *A. S. Surg* 1946, 3, 32.

The observations presented were made on 341 abdominal war wounds operated upon in a single evacuation hospital from the middle of June, 1944

through December 1944 in the European theatre. The distance of the hospital from active fighting varied from 4 to 30 miles. The cases include all of those with penetrating and perforating wounds involving the peritoneum perforating wounds of the rectum and major retroperitoneal injuries requiring celiotomy.

The diagnosis of intra-abdominal perforation was usually obvious in battle casualties. Signs of peritoneal irritation were frequently absent during shock, but appeared when it was relieved. Symptoms of peritoneal irritation appeared late in wounds of the left colon, and a silent abdomen was the rule when peritoneal irritation was present. Shoulder pain was not important, and the absence of liver dullness was not a constant finding. Proctoscopy and sigmoidoscopy were invaluable in uncovering rectal and sigmoid perforations. Location of the foreign body roentgenologically was helpful. Urinary alysis was a routine procedure in all cases of abdominal injury and with catheterization was useful in exposing wounds of the urinary tract. When in doubt as to whether intraabdominal perforation existed, an exploratory laparotomy was done.

Preoperative management is stressed as being frequently the decisive factor in the outcome of cases of abdominal injury. All patients were sent to the shock ward first, whether shock existed or not. Both blood and plasma were used but the former was believed to be of most value and a quantity of 1 liter or more was usually necessary to relieve shock in individual cases. Patients with active intra-abdominal bleeding and abdominal eversion were sent directly to surgery with blood running because they did not respond to shock therapy until surgery was done. In judging the optimum time for surgery the patient's general condition and skin warmth were valuable aids. Single blood pressure readings were misleading but multiple readings were helpful. However patients with a blood pressure of below 80 systolic did not tolerate surgery well. The time interval before surgery was not found to be important except in cases of continued bleeding and eversion at intervals and some patients under shock therapy were operated upon as late as 36 hours after injury however the policy was to give all patients the benefit of surgery whether or not they responded to shock therapy.

The mortality in the cases of patients who were operated upon 6 hours from the time of injury was 30 per cent. The mortality dropped in the subsequent six hour periods until at the 24 to 30 hour period it was but 10 per cent. The high early mortality was partly explained by the fact that the most desperate cases were operated upon first.

Where multiple major wounds existed the policy was to perform the separate procedures over a period of days rather than have several operative teams working at the same time.

In most cases the anesthetic of choice was nitrous oxide-oxygen, and ether in a closed system prefer

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In most cases the anesthetic of choice was nitrous oxid oxygen, and ether in a closed system, prefer

ably with intratracheal intubation. Open drop ether was valuable for patients in severe shock from internal hemorrhage. Spinal anesthesia and pentothal were unsatisfactory.

In combined chest and abdominal wound the thoracic problem was handled first. The trans-thoracic approach to the diaphragm was most useful in treating wounds of the diaphragm, spleen and some gastric wounds. Paramedian incision with separation of either of the recti muscles were used most frequently. Exposure through subcostal incisions proved very useful especially in cases with injuries of the stomach, liver and spleen and the hepatic and splenic flexures of the colon.

The authors state that systematic examination of the abdominal contents is important. Suture of wounds of the small bowel is preferable to resection and end-to-end suture was the procedure of choice following resection. Enterostomy of the small bowel should not be done.

Small wounds of the cecum and ascending colon were sutured and a large Pezzar catheter was placed in the cecum as a safety valve. In the transverse descending and sigmoid colon the Mikulicz or preferably the loop-type of colostomy was performed. In rectosigmoid perforations those within the peritoneal cavity were sutured with a proximal

terminal sigmoidostomy to divert the fecal stream. In extraperitoneal perforations of the rectum adequate drainage with removal of the cecum if necessary and a proximal colostomy were done.

Wounds of the liver were managed by packing or the use of free or clef graft. Wounds of the spleen usually required peritonectomy.

Abdominal incisions were carefully closed in layers and reinforced with silk or wire retention sutures. Drainage of the peritoneal cavity was unnecessary except in cases of wounds of the liver.

Postoperative care included adequate hydration and the liberal use of plasma and whole blood to maintain blood protein levels. Wagon tree serum was used actively in all postoperative abdominal cases. Penicillin was given prophylactically in the immediate postoperative period. Vitamin C and thiamin were given orally. Penicillin was used routinely in all cases and is given partial credit for the low incidence (1.6 per cent) of pulmonary infection. Postoperative wound infection was rarely encountered and this was attributed to the use of penicillin and the sulfadiazine also postoperative intestinal obstruction in the early postoperative period even after extensive surgical procedures was rare.

JAMES K. H. 1971 MD

GYNECOLOGY

UTERUS

Elsen, D., and Goldstein, J.: Lipiodol Intravasation during Uterosalpingography with Pulmonary Complications. *Radiol* 57 1945 45 603

The accidental intravasation of lipiodol into the venous system of the uterus during uterosalpingography has been repeatedly described in the literature. As a rule there were no ill effects except perhaps slight temporary leucocytosis. In rare cases pulmonary and cerebral embolism and pulmonary infarction were noted.

In an attempt to study the mechanism of lipiodol embolism in the lungs Sicard and Forestier injected from 2 to 4 c.c. into the cubital vein. The lipiodol reached the lungs in 3 or 6 seconds remained there for from 6 to 8 minutes and then suddenly disappeared. The only effect in the patient was a slight cough. Walther injected lipiodol into the ear vein of rabbits. He found that practically all of the oil became arrested in the lungs where

it underwent two processes. The major part was broken up into iodine and fat, the iodine being excreted through the kidneys during the first 4 days as potassium iodide and the fat being saponified and carried away by the circulation. A smaller part of the lipiodol became phagocytosed. Walther also suggested that an inflammation may develop around fat droplets because of bacteria carried along by the lipiodol from the uterus.

A review of the literature revealed that the various authors attributed the intravasation to trauma of the endometrium during the injection, to excessive pressure and to an increased permeability of the receiving sinuses such as is observed in idiopathic uterine bleedings or immediately after menstruation.

The authors themselves noted intravasation of lipiodol during uterosalpingography in a woman 25 years of age. The case is briefly described and illustrated (Fig. 3). The afternoon after the injection the patient developed a dry cough with a temperature of 102 degrees. The next day her cough increased and she brought up bloody sputum. The temperature remained high until the fourth day when it dropped to normal. The cough persisted, however, and a roentgenogram of the chest on the sixth day revealed a dense patchy opacity involving the lower two-thirds of both lungs. Another roentgenogram 1 month later showed practically a normal appearance.

In conjunction with this case the authors recommended the following precautions: (1) uterosalpingography should not be performed sooner than from 8 to 10 days after the menstrual period or any operation on the uterus; (2) the position of the uterus should be determined preliminarily by the use of a sound and in case of angulation the injection should be done by properly circumventing the angulation so as to avoid trauma to the endometrium; (3) the pressure of the injection should not exceed from 140 to 200 mm. of mercury a manometer being used for control; and (4) the amount of lipiodol injected should be no more than is necessary to fill the uterus and tubes with a slight spill.

T. LECUTIA M.D.

Morris, P.: Hydrometrocolpos in Infancy—A Cause of Urinary Retention, Intestinal Obstruction and Edema of the Lower Extremities. *Am J M* 54 1945 75

A 7 weeks old girl who had been passing thin ribbonlike stools with difficulty for about 3 weeks, and for a day had only slightly wet two diapers, suddenly developed swelling of the feet and a purplish discoloration of the lower extremities. Also the previous day blood flecks had appeared in the stool and intussusception was suspected because of the presence of a mass in the lower abdomen. In



Fig. Lipiodol intravasation into uterine venous plexus and the ovarian vein. The latter resemble ureters, being filled their entirety on the right side the vena cava and on the left up to and including the renal vein.

addition to the large cystic mass extending upward from the pubis and apparently slightly more toward the right side reaching to 2 cm. above the umbilicus, there was a peculiar bulge at the vulva, cystic in appearance, pointing anteriorly and somewhat resembling a rectocele with the distended viscus pushing into it.

At laparotomy after the bladder had been emptied by catheterization a second mass appeared behind it. This was recognized as the distended uterus and vagina. Pressure on this mass, which was only about 5 cm. in diameter caused an increased tension in the vulvar hudge which was then incised externally. A considerable amount of a thin slightly milky fluid escaped and the mass collapsed, which allowed the rest of the urine to be emptied easily from the bladder. The fluid contained some white blood cells but the culture was sterile. The child died about a week later death apparently having nothing directly to do with the abnormal condition reported.

The author thinks that patients with hydrometocolpos should not ordinarily be subjected to laparotomy as simple incision of the vaginal membrane entirely relieves the condition. Preliminary aspiration by needle of some of the cyst fluid and injection into the cyst of 50 c.c. of diatriz followed by anteroposterior and lateral roentgen ray views (as suggested by Mahoney and Chamberlain *J. Pediat.*, 1940, 17, 772) will clearly establish the diagnosis of the condition.

The author wonders if many of these patients are not escaping detection as the condition becomes more or less quiescent about 2 weeks after birth when the glandular activity of the vagina and cervix regresses with exhaustion of the store of circulating estrogen left by the mother. With an imperforate condition of the hymen or residual embryonic vaginal septum as the case may be, the condition may develop again about the time of puberty and lead to the later development of the not infrequently observed hemistocolpos of the adolescent girl.

JOHN W. BRENNAN M.D.

Calvo M. and Botella, J.: Hormonal Conditions in Uterine Myoma and the Genesis of the Menstrual Disturbances in Myomatous Women (Sobre las condiciones hormonales en el mioma de útero y la génesis de los trastornos menstruales de las miomatosis). *Rev. españ. obst.*, 1945, 3, 87.

This article is the third of a series of publications by these same authors in preceding numbers of this same journal, of which the first (Calvo y Botella *Rev. españ. obst.*, 1944, 1, 1) demonstrated the pre-dominance (four fifths of the patients with myoma) of incomplete cycles that is persistent follicles and anovular cycles. The second (*Ibid.*, 1944, 1, 165) showed that in almost three fourths of the myomatous women the secretory phase of the menstrual cycle did not develop. These findings corresponded closely to those in the first article. In addition the reader is referred to the thesis of one of the authors (Calvo Marcos *Tesis doctoral*, Madrid 1943) for a

detailed discussion of the techniques employed in this series of investigations.

In the two previous articles the investigations had led the authors to believe that there is actually an inundation of the blood of the myoma patient by estrogenic hormone viz. that the blood hormone is higher than normal, although the excess seems due rather to a constancy of secretion (anovular cycle) than to a high titer at any one phase. This constancy of secretion is designated by the authors as a rhythmic hyperestronism. It also seemed to them that the pathological bleeding so characteristic of the myoma has a functional origin that is it is bound up with the endometrial functional changes incident to normal menstruation.

In this report, on the other hand there are presented the shortcomings in the authors' findings, militating against unqualified acceptance of any such conclusions as those just cited.

The urine of 8 myomatous patients was tested for the elimination of estrogenic hormones on castrated adult white mice according to the method of Siebek and, although it is admitted that the urinary estrogenic elimination is not now regarded as a reliable criterion for indicating its level in the blood, it was found that the urinary elimination was neither constant nor excessive. In only 2 instances was the titer higher than normal and even in these cases the excessive elimination was not very marked and the tentative inference is offered that the endocrine disturbances of the myoma are due rather to the continuity of follicular secretion (anovular cycle) than to an actual increase in quantity at any particular time.

In studying their material the authors found that the incidence of the various patterns of menstrual manifestations in myoma showed in accord with practically all statisticians on this subject, a rather striking correlation of figures under all conditions. In their own material there was more than 50 per cent of patients complaining of menorrhagias more than 10 per cent with metrorrhagia, 3 per cent with eumenorrhagia and 4 per cent with amenorrhoea, and these proportions of characteristic manifestations were maintained except perhaps for a slight pre-dominance of copious menorrhagias in the frankly hyperplastic endometrial specimens no matter what endometrial phase was present.

The authors therefore, conclude from these studies that the bleeding in these myomatous patients is not due to a hormonal metropathy but rather to a vascular condition. In conformity with the older theories it is believed that it is due to the power of the myomatous new growth to induce congestion and changes in the capillary walls in the tissues overlying and contiguous to it. This perhaps is dependent upon its ability to produce some substance such as histamine or histaminoid substances and the effect is perhaps more or less sustained by the poor contractility and cavity deformation which is presented by the uterus itself.

JOHN W. BRENNAN M.D.

ADNEXAL AND PERIUTERINE CONDITIONS

Jones, G. E. S., and Te Linde, R. W.: The Curability of Granulosa Cell Tumors. *Am J Obst* 945 50 691

Three cases of granulosa cell tumors have been reported in which recurrences developed not less than 14 years after the original operation.

All 3 patients died 18, 20 and 21 years respectively following the removal of the primary tumor in spite of the fact that the tumors were well encapsulated and showed no evidence of metastasis or implantation at the original operation. One tumor recurred in spite of bilateral salpingo-oophorectomy and hysterectomy.

One case, with widespread inoperable abdominal metastases, responded well to deep x ray therapy over a period of 3 years, but a subsequent recurrence of the growth proved refractory to treatment.

The total urinary estrogen values in 2 cases were not extremely high but stood within the range of values for normal cyclic women. However the values were well above those usually found in the authors' laboratory for postmenopausal women. All 3 of the patients fell into this age group at the time of the tumor recurrence. All 3 cases exhibited clinical signs of estrogenic activity at that time.

EDWARD L. CORNELL, M.D.

Usandizaga, M.: Tumors of the Round Ligament (Los tumores del ligamento redondo). *Rev chir* 1945 3 75

The author's patient was a woman of 39 years who had been married for 18 years and had gone through 3 pregnancies with normal childbirth in each instance. She entered the Provincial Maternity Hospital at Zaragoza with progressive enlargement of the abdomen since about 5 months previously and rather mild pains in the hypogastrium radiating into the lumbosacral region.

Examination revealed a hypogastric mass some what smaller than the head of an adult person of hard consistency very firmly fixed and with an irregular nodular surface. The impression of a small retroposed uterus was also obtained. The diagnosis was that of an intraligamentary solid tumor.

At operation a tumor mass was uncovered. It was somewhat smaller than an adult man's head with multiple lobulations and of firm consistency. It was situated almost entirely beneath the peritoneum. The mass appeared to be in direct continuity with the uterine end of the round ligament. On the right side the ligament passing intact from the uterus for about 3 cm. before being engulfed by the tumor mass. The broad ligament was well preserved, the tube and ovary of that side presenting a normal appearance. The peritoneum was freely movable on the surface of the tumor and the latter was easily enucleated. The uterine segment of the round ligament was sectioned and the coagulation carried to the region of the internal inguinal ring where a small vascular pedicle was likewise cut and tied. The tumor could

then be lifted out and the exact impression was given as though the round ligament had been excised between ligaments for its entire extent. This was followed by peritonization, closure of the abdomen, and an eventless postoperative course.

Histological examination of the tumor disclosed that its texture consisted of abundant trabeculae of smooth muscle cells in a framework of fibrous tissue.

An extensive bibliography is appended to this report of an extremely rare form of tumor.

JOHN W. BRECKEN, M.D.

EXTERNAL GENITALIA

Quinet, A.: Tuberculosis of the Vulva and Cervix—Contribution to the Medical Statistic of Brazil (Tuberculose da vulva e cervix—contribuição à casuística nacional). *A Brasil gin.*, 1945 10 1

The case of a negro woman of 34 years who had given birth to 7 full term children is here reported. It was one of the relatively rare instances of tuberculosis which attack the female sexual organs and one of the even rarer exemplars of the disease in which the attack was made on the cervix of the uterus. Finally it was one of the very rare cases in which the vulva was involved in the tuberculous ulcerative condition. In fact the author states that this is the first instance of vulvar involvement to be reported in the medical literature of Brazil.

The patient visited the out patient department (medical division) of the Hospital Moncorvo Filho in Rio de Janeiro a year and a months after the birth of her last child complaining of physical and mental exhaustion and weakness, loss of weight and pains in the region of the lower abdomen which became worse on exertion. Physical examination at this time disclosed some disseminated subcutaneous rales in the chest but no evidence of any involvement of the pelvic organs. A month later however the pains had become worse. The patient entered the hospital and was assigned to the medical section, where a small amount of ascites was determined and a hemorrhagic liquid showing no trace of the Koch bacillus was aspirated from the right pleural cavity. Paracentesis of the abdomen likewise yielded an ascitic fluid without trace of tubercle bacilli.

At the end of 2 months the effusions had cleared and the pains were gone. However the vaginal discharge was very marked and the patient was sent to the gynecological division. Here large irregular fixed masses were found on both sides of the cul-de-sac of Douglas and since one of these had begun to enlarge and soften the patient was transferred 15 days later to surgery where the intrapelvic process developed to the point where the uterus and other pelvic organs became enveloped in a single tumor mass.

At laparotomy some time later 2 liters of caseous, purulent material rather fetid and of a yellowish green color were aspirated from the mass in the pelvis and a biopsy specimen was taken from the

lining membrane of the pus pocket. On histological examination this specimen confirmed the suspected diagnosis of tuberculosis. No further surgical procedures appeared possible and the abdomen was closed.

It appears that it was during this later period that there developed from the anterior lip of the cervix the indolent appearing ulcerative process with sharply punched out edges and sluggish lardaceous floor which spread down the anterior wall of the vagina, and one patch about $\frac{3}{4}$ inch in diameter appeared on the internal aspect of the left labium major.

Biopsy specimens from the vulva, portio vaginalis, endometrium and endocervix disclosed (as depicted in excellent photomicrographs in the original article) the vascular characteristics lymphoid plasma, and Langhans cells as well as the scattered alcohol resistant bacilli of tuberculosis. The mycobacterium tuberculosis was cultured on Lowenstein medium and guinea pig inoculations proved positive.

JOHN W BRENNAN M.D.

MISCELLANEOUS

Dujovich, A.: Elytrocele (Eltrocele) *A. brasil gin.* 1945, 10: 116.

The elytrocele also variously known as vaginal hernia, enterocele vaginalis posterior Douglascele, prolapse of Forrie's hernia of the floor of the sac of Douglas, and colpocele posterior is rare but nevertheless more frequent than the anterior form of vaginal hernia. It is particularly important not to confound this condition with rectocele since a simple repair of the latter when accompanied by elytrocele, will usually result in recurrence. However other forms of defect of the pelvic floor usually accompany the elytrocele. It is well to be prepared to repair these at the same time.

The case history presented by the author was that of a woman of 55 years who had given birth to 3 children. Twenty nine years ago 4 years after the first accouchement she had noted a protrusion of the vulva, which was painful on physical exertion. The

condition became gradually more pronounced until 19 years ago when she underwent a pelvic repair—probably an anterior colporrhaphy and a colpoperineorrhaphy—with relief for 4 years. Then the protrusion and other symptoms returned. A pessary was worn for 7 years without relief and during the past 3 years the patient suffered from a sensation of heaviness in the vagina and on exertion a globular mass protruded from the vulva. The diagnosis at this time was genital prolapse colpocele, anterior cystocele, hypertrophic elongation of the uterine cervix colpocele rectocele and vaginal hernia of the pouch of Douglas (enterocele).

At operation which was entirely vaginal, the anterior wall of the vagina, together with the cystocele was first repaired and the elongated cervix amputated. The incision was then carried around back of the cervical stump and the posterior surface of the latter was followed closely to guard against injury to the hernial sac. The sac, however was easily identified and freed up to its neck. When the sac was opened, it was found to be lined with the peritoneum of the pouch of Douglas and to contain a loop of the sigmoid colon. The sigmoid was pushed back through the neck 3 fingers in width which was then closed by a purse string suture with No. 1 catgut and the sac itself was cut away. The closure was in turn reinforced by additional sutures including the posterior surface of the cervix and the rectovaginal fascia on each side, which had been previously dissected loose from the posterior vaginal mucosa. The vaginal mucosa was then sutured with interrupted sutures of No. 2 catgut to the posterior surface of the stump of the cervix, and the entire operation finished up with repair of the residual rectocele including the usual myorrhaphy of the levator muscles.

It is now a month since the patient was operated upon although there is some shortening of the vagina she seems to be definitely cured. Indeed, the prognosis is generally good in these patients, provided that the condition be correctly recognized.

JOHN W BRENNAN M.D.

OBSTETRICS

PREGNANCY AND ITS COMPLICATIONS

Dieckmann, W. J., Turner D. F. and Ruby H. A.: Diet Regulation and Controlled Weight in Pregnancy. *Am. J. Obst.*, 1945 50 701

The pregnant patient must have a proper diet, but this does not mean that she should have an unlimited caloric intake and, as a result, gain excessively in weight. The pregnant patient does not have to eat for 2 of her own size. The diet must be increased during the last trimester.

The necessary weight gain due to the physiological changes of pregnancy—fetus, placenta, amniotic fluid, uterus, blood volume, breasts—amounts to 6.7 kgm. Chesley calculates from reports in the literature a gain of 6.2 kgm. for the same physiological changes in pregnancy. There is no need for a total weight gain greater than 8 kgm. above the ideal weight. The first 3 months of pregnancy are characterized by either a little gain or a loss of weight. The average weight gain for the remainder should then be a maximum of 225 gm. (½ pound) per week.

Every patient whose total weight gain is over 10.9 kgm. does not necessarily have toxemia. Statistics show, however, that the incidence of toxemia is increased in the patients who gain more than 13 kgm.

If the patient's weight is ideal before pregnancy the maximum gain should be between 7 and 8 kgm. A diet containing 1,800 calories is required.

EDWARD L. CORRELL, M.D.

Lagercrantz, C. Electrophoretic Analysis of Serum in Pregnancy and in Pregnancy Toxemia. *Uppsala läk. fören. förh.*, 1945 5 17

An analysis of serum proteins in pregnancy and in pregnancy toxemia has been carried out previously by gravimetric, nephelometric, refractometric, or precipitation methods. These methods have shown quite consistently that during pregnancy both the concentration of serum proteins and the albumin-globulin ratio are lowered. These findings are more pronounced in toxemia, especially in cases in which there is much edema. Previous investigators assuming that the well recognized increased plasma volume of pregnancy is due largely to a plasma hydropnea have suggested that the decreased protein content is in the main a dilution effect. Because this decrease in total protein is due solely to a lowered albumin, they have regarded the unchanged value of the globulin as an expression of an absolute increase of this protein in the plasma. In pregnancy toxemia where still lower albumin values are found it has been suggested that these values are the result not only of further dilution but also of real loss of albumin. In the present study serum proteins were analyzed by

electrophoresis. The technique is carefully described.

Electrophoretic analysis was performed on serum from 16 normal nonpregnant women, 9 normal pregnant women in the second to seventh months of gestation, 15 normal pregnant women in the last month of gestation, and 19 pregnant women in the last month of gestation with varying degrees of toxemia. The analysis showed that:

1. The alpha and beta globulins increase both relatively and absolutely during normal pregnancy.

2. The albumin and total protein decrease during normal pregnancy.

3. Women with toxemia have a both relatively and absolutely larger alpha globulin than normal pregnant patients.

4. There is no significant difference in the electrophoretic patterns of umbilical cord serum after a normal pregnancy and after a toxemic one. Umbilical cord serum shows small amounts of alpha and beta globulins.

The author correlates these results with previous work, although he makes no attempt to draw any significant conclusions.

The alpha and beta globulins consist partly of lipids. It is known of course that in pregnancy the serum lipids are elevated. The increase in these globulin fractions may be related to the lipemia. In view of the small amounts of alpha and beta globulin found in the umbilical cord it is unlikely that the increase is caused by a transfer from the fetus.

The molecular weight of both alpha and beta globulin is much higher than that of either albumin or gamma globulin. Consequently in toxemia, when the permeability of the capillary walls may be pathologically increased, albumin and gamma globulin should leak through first and lead to a relative increase of alpha and beta globulin. The absolute increase, however, must be explained by some other factor than filtration alone.

L. JAMES TALBOT, M.D.

Gimeno, A. M., and Orengo, F.: Capillaroscopy in the Toxemias of Pregnancy with Special References to Differential Diagnosis (La capillaroscopia en las toxemias de embarazo, con especial referencia al diagnóstico diferencial). *Rev. esp. obst.*, 1945 5 2.

This is the conclusion of an article begun in the July issue of this same journal in which details of the technique and the criteria established by the authors in judging the results of their observations will be found.

The authors examined capillaroscopically 100 cases of toxemia, including 3 of chronic nephritis, 3 of vasculorectal disease, 22 of essential hypertension, 47 of mild pre-eclampsia, 17 of severe pre-eclampsia.

and 5 of eclampsia. These capillaroscopic examinations were made in the course of a broader investigation employing numerous other tests and methods of study such as blood pressure studies and studies of edema, of the effects of the administration of pituitrin and of congelation of the hematocrit findings of albuminuria and of sedimentation, and the results were correlated. When possible the observations were made both before and after delivery.

Capillary architecture does not show sufficient modification to permit of differentiation between the mild and the severe pre-eclampsia. Acute nephritis is distinguished by marked anomalies of form such as undulation serpentine formation intercrossing, anastomosis, visibility of the subpapillar plexus of the blood vessels. There are no characteristic alterations in the picture of essential hypertension. In chronic nephritis and in vasculorectal disease deviations of form are, in the first instance scarce (undulation, some serpentine deformities and at times visibility of the subpapillar plexus). In the second condition there are even fewer abnormalities consisting solely of a certain amount of diminution in the number of capillaries per field each vessel being somewhat narrower on the whole.

In general it is possible to demonstrate a relationship between the clinical picture and the capillary findings, however incongruities are frequently present. The blood current in acute nephritis can show findings as poor as those in eclampsia, and by the same token, much worse than those in chronic nephritis. In cases of essential hypertension and in vasculorectal disease there is a persistent constriction of the vascular bed with changing blood current velocities and at times an accelerated or even violent circulation.

The postpartum capillaroscopic examinations result in two classifications: the genuine toxemias (pre-eclampsia and eclampsia) and a group comprising all the other processes cited (chronic). In the first group the authors observe a total recuperation or at least a tendency toward recovery; in the second an established condition with slight modifications persists. The value of a careful postpartum revision for substantiating the diagnosis is seen.

The authors consider capillaroscopy a diagnostic method, which aids in the differentiation between genuine toxemias and vascular disease or a chronic kidney condition especially when employed in the postpartum period. It also possesses a limited but evident value in prognosis and may serve as a guide in bringing out the effectiveness of therapeutic methods the authors having frequently observed the improvement with diet with magnesium sulfate and especially with hypertonic glucose solution.

JOHN W. BRENNAN, M.D.

Davis, L. J., and Forbes, W.: *Thiouracil in Pregnancy; Its Effect on the Fetal Thyroid*. *Lancet*, Lond. 1945 249-250.

A case of mild thyrotoxicosis in a woman who was treated with thiouracil prior to and during preg-

nancy is presented. She died in the sixth month of pregnancy. The cause of death was uncertain despite autopsy examination.

The thyroid gland of the fetus was enlarged and hyperactive, as compared with a presumably normal gland from a premature infant, and showed histological evidence of considerable functional activity. It resembled the gland of an adult receiving too much thiouracil. It is suggested that thiouracil acts on the fetal thyroid after passing through the placenta. The administration of thiouracil to pregnant women and probably to nursing mothers demands caution.

GEORGE BLINCK, M.D.

Beerman, H. and Ingraham, N. R. Jr.: *Recent Advances in the Management of the Syphilitic Pregnant Woman*. *Med. Clin. N. America*, 1945 39-1463.

There is now general agreement that syphilis is exclusively transmitted to the fetus by the mother. Most evidence shows that the fetus is infected in the later months of pregnancy and not shortly after conception.

Routine blood testing in prenatal patients becomes a matter of great importance because 90 per cent of the women are unaware of their infections. In the experience of the authors there is no evidence that pregnancy impairs the sensitivity or specificity of the tests.

In the treatment, drugs with a strong spirillicidal action must be used. These are neosarsphenamine, arsenoxide and penicillin. Bismuth and mercury alone are not effectual. An outline for the use of these drugs is given, with the greatest discussion being devoted to penicillin. Treatment began at the fourth month of pregnancy and continued at weekly intervals to total not less than 4 gm. of neosarsphenamine, or the equivalent of arsenoxide with or without bismuth subsalicylate. Pregnant women tolerate arsenical and heavy metal treatment well but a urine examination and blood pressure determination before each treatment is important.

Penicillin therapy is the same as for the nonpregnant adult. The spirochaeta pallida was seldom found in the open lesions longer than 12 hours, and the lesion itself was completely healed in 1 week. The therapeutic shock at the beginning of treatment may be harmful to the fetus. A large percentage of the women develop abdominal pain, gastrointestinal disturbances and on several occasions presented symptoms of threatened abortion. For this reason the initial dose is reduced for the first 48 hours. A total dosage of either 1,300,000 or 2,400,000 Oxford units of sodium penicillin is satisfactory both to prevent infection of the fetus and to cure the disease in the mother. This total dosage is given intramuscularly 30,000 units every 3 hours with a reduction during the first 8 hours. The total treatment course takes 8 or 9 days.

Twenty-seven of the women treated at the University of Pennsylvania Hospital (Philadelphia) have thus far been delivered and their babies followed up

for periods which vary from 3 months to a year with no evidence of syphilis.

CATHERINE B. HART, M.D.

LABOR AND ITS COMPLICATIONS

Reanick, L. Spinal Analgesia in Operative Obstetrics. *Brit. M. J.* 1945 3 72

Although the safety of spinal anesthesia for general surgery has been generally accepted, its use in obstetrics is still considered dangerous. The author reports a series of 137 cesarean sections and 256 operative vaginal deliveries done under heavy narcosis (1 in 200 in 6% glucose in 3 c.c. ampules) spinal anesthesia.

Premedication was given to all women who were to be delivered by cesarean sections. It consisted of omopon gr 1/3 and scopolamine gr 1/300, given about 45 minutes before operation, and in addition, atropine gr 1/100 and ephedrine gr 1 for vaginal deliveries most of them had had some premedication during the labor but were given ephedrine gr 1.

The dosage for cesarean sections varied from 1.5 to 1.5 c.c. of the solution and for vaginal deliveries from 0.5 to 0.8 c.c., which gave anesthesia to just below the umbilicus.

The indications for and the types of cesarean section performed are summarized. 75 per cent of the sections were of the lower segment type. Of the 256 vaginal deliveries 136 were made by means of the outlet forceps, 108 by midforceps, 8 by high forceps, 6 by breech extraction, and 4 by craniotomy. Rotation of the head was performed 167 times.

No maternal deaths occurred in the cesarean group, while 2 of the patients delivered from below died (one because of pulmonary embolus and the other following sulfonamide therapy for pyelitis). In neither case was the anesthesia responsible for the death. Seven (5%) of the cesarean babies and 34 (13%) of those delivered from below died but none of these deaths could be attributed to the anesthesia.

The author considers the following to be the advantages of spinal anesthesia:

For the mother

1. It is safe when inhalation anesthesia is contra indicated.
2. It is safe in pre-eclampsia and eclampsia.
3. It is safe in essential hypertension.
4. Uterine atony and hemorrhage are rare.
5. Obstetric shock is rare.
6. Pulmonary complications are rare.
7. Postoperative discomfort is absent.

For the physician

1. The technique of its use is simple.
2. It may be used when skilled anesthetists are not available.
3. It affords maximal relaxation of the pelvic muscles.
4. No additional anesthesia is needed for repairs.

The contraindications to spinal anesthesia are:

1. Cases in which the central nervous system or spinal disease interferes with aseptic technique.
2. Abnormal presentations.
3. Blood pressure below 100 mm. of mercury.
4. Acute shock.
5. Acute heart failure.
6. Constriction ring dystocia.

J. ROBERT WILLSON, M.D.

NEWBORN

Wilwell, G. B. Anemias of the Newborn. *Cesal. M. Ass. J.* 1945 33 555.

Anemia is defined as any state in which the hemoglobin is less than normal in proportion to the blood volume. This state can arise from several causes such as blood loss, failure of cell formation or hemoglobin, excessive cell destruction or combinations of these.

These anemias are reviewed under four headings:

Anemia due to hemorrhage. Hemorrhage may be suspected if the red cells drop to 4,000,000 with a corresponding reduction in hemoglobin. It is a hypochromic type becoming microcytic if the loss continues. Nucleated red blood cells appear and the reticulocytes increase. The leucocytes increase to from 20,000 to 30,000 and the platelet count is normal or raised.

Traumatic hemorrhage usually occurs in the first two days and may be severe enough to cause anemia.

The two most common diseases of the newborn giving rise to spontaneous hemorrhage are:

Hemophilia which is rare. The clotting time may be prolonged for hours but the blood eventually clots. Treatment consists of frequent transfusions.

Hypoprothrombinemia. This is very important and takes the form of constant oozing. It usually appears between the second and eighth day. Marked increase in the prothrombin time alone characterizes this condition. Vitamin K administration to the mother in labor or intramuscular injection of the newborn is remarkably efficacious in preventing or benefiting this condition.

Anemia of infection. The hematopoietic systems of babies vary in their vulnerability to infection. Anemia lowers the resistance to infection and infection aggravates the anemia. Severe pyogenic infections, septicemia, pyelonephritis, and pneumonia may cause a serious drop in hemoglobin. Streptococcal and bacillus coli infections are more likely to cause anemia than streptococcal infections although a hemolytic staphylococcus may cause severe anemia even of an aplastic type.

Congenital syphilis is the chief offender of the chronic infections.

Acute congenital hemolytic anemia may rarely follow infection and sickle cell anemia, occurring only in negroes, may be precipitated by infection.

Repeated transfusion is the treatment of choice and if the anemia persists there has probably been some destruction of the bone marrow.

Anemia of prematurity This type is characteristic of all immature infants and its severity is governed by the state of maturity. The anemia may not reach its maximum for from 8 to 10 weeks and at 3 months a gradual improvement sets in. Various workers have shown that iron is not directly involved in the causation of this anemia. Immaturity of the hemopoietic system makes it difficult for these infants to perform postnatal adjustments and to recover the normal volume of blood and its constituents.

In the early stages it is a normocytic normochromic anemia. Microcytosis occurs later. The prothrombin time is often increased.

These babies are potential bleeders and they require vitamin K more urgently than normal infants. Treatment with iron is of some use only after the third month at which time there is a natural spontaneous tendency toward recovery. Transfusion has only a transitory effect and is used only to combat infection and complications.

Anemias due to hemolysis These are for the most part related to the Rh factor and its workings. The author gives a good review of the mechanism by which Rh incompatibilities cause hemolysis of the blood cells in infants and subsequent anemias. The hemoglobin may fall to 20 per cent and the red blood cells to 1,000,000. The treatment is multiple transfusions of Rh negative blood.

HARRY FIELD, M.D.

MISCELLANEOUS

Tompkins P: The Timing of Ovulation with Basal Temperature Graphs *Med Clin. N. America* 1945 39 1435.

Graphs of the daily basal body temperature have been used by the author as an index to ovulation in

cases of sterility. Special graph paper or improvised paper is suitable. The patient is instructed to take her temperature rectally with an ordinary clinical thermometer each morning upon awakening and before rising drinking eating and smoking. It is to be recorded if any acute infection exists at the same time although marked upper respiratory infections produced practically no change in the rectal temperature. The results of this method concur with the established theory that ovulation occurs on the fourteenth day before the menstrual period regardless of the intervals of the periods.

The time of ovulation is marked by a rise in rectal temperature, which is sustained for several days and is usually preceded by a slight fall in temperature. If intercourse occurs near the time of the temperature shift there will be a better chance of conception than if intercourse occurs only at other times in the cycle. The span during which the ovum is susceptible to fertilization is believed to be from 12 to 24 hours. The author states that the length of pregnancy is 266 days rather than the accepted 280 days.

The reason for the temperature shift is not established. Two suggestions are offered (1) that progesterone elevates the temperature and (2) that during the preovulatory phase the temperature is depressed by estrogens.

The basal body temperature graphs can be used for the following (1) to determine the time of maximum and minimum fertility (2) to determine the time for artificial insemination and endometrial biopsies (3) to aid in securing early human ova (4) to help in evaluating the effectiveness of treatment designed to produce ovulation, especially x ray therapy and (5) in occasional cases to predict the date of delivery. CATHERINE B. HESS, M.D.

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CATHERINE B. HESS, M.D.

LABOR AND ITS COMPLICATIONS

Resnick, L.: Spinal Anesthesia in Operative Obstetrics. *Br. M. J.* 1945 2 722.

Although the safety of spinal anesthesia for general surgery has been generally accepted its use in obstetrics is still considered dangerous. The author reports a series of 137 cesarean sections and 256 operative vaginal deliveries done under heavy nitroperalin (1 in 300 in 6% glucose in 3 c.c. ampules) spinal anesthesia.

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J. ROBERT WILLIAMS, M.D.

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GENITOURINARY SURGERY

ADRENAL, KIDNEY AND URETER

Peters, J. T.: Origin and Development of a New Therapy for Crush Injury Transfusion Kidney and a Certain Number of Other Diseases. *Acta med. scand.* 1945 123 90.

Considering the fact that a part of the kidney function is a mechanical filtration process the author constructed an artificial nephron of glass and rubber. By means of this apparatus it could easily be demonstrated that not only oliguria and anuria but also polyuria could be imitated by a purely mechanical device. The imitation anuria was produced without any obstruction, as a result of increased intrarenal pressure which caused a decrease of the effective filtration pressure.

The presence of an increased intrarenal pressure in vivo is readily deduced from certain pathological findings. Thus the obstruction of the tubules by blood clots, cell detritus and crystals is often found at autopsy to be present only in a small part of the kidney or it is altogether absent. An obstruction, therefore is unnecessary for the development of anuria.

In mercury poisoning crush injury transfusion kidney and several other diseases oliguria or anuria associated with hyperazotemia and uremia is the important syndrome. For the treatment of these conditions, decapsulation of the kidney is recommended, on the assumption that the condition is the result of increased intrarenal pressure. This should be considered an emergency operation, and should be done on the first day that the syndrome develops.

Uremia caused by glomerular destruction, however must be sharply differentiated from the uremia caused by increased intrarenal pressure. The former cannot be cured by lowering the intrarenal pressure by a few millimeters of mercury. In the latter decapsulation, diuretics and pressor drugs are now widely used either separately or in combination, and apparently with success. SAMUEL KARW M.D.

Abramson, D. J.: Renal Typhoid Fever; Presentation of a Case of the Primary Type. *J. Urol. Balt.*, 1945 54 432.

A case of primary renal typhoid is presented. It is of additional interest because of the presence of calculi and pyelonephrosis. Enteric typhoid had been consistently excluded by negative clinical findings, Widal tests, and stool and blood cultures.

Emphasis is placed on the necessity of careful bacteriological examinations of routine urinary cultures, the lack of significance of Widal tests in previously immunized individuals and the value of conservative treatment. The role of sulfonamides in renal typhoid deserves further study.

Both primary and secondary renal typhoid are discussed. The epidemiological significance of ty-

phoid disease of the kidney and of the carrier state is emphasized. JOHN A. LOFF M.D.

Jacobs, A.: Tuberculous Disease of the Kidney. *Glasgow M. J.* 1945, 144:161.

The author presents a set of concepts for dealing with tuberculous disease of the kidney based on a series of over 250 nephrectomies and a further untotaled series of unoperated cases of renal tuberculosis. He divides the disease into three main clinical groups: tubercle bacilluria without urinary symptoms; renal involvement with signs and symptoms confined solely to the urinary tract and no other obvious tuberculous focus; and renal involvement appearing subsequent to the occurrence of an extra renal lesion.

Tubercle bacilluria according to the author requires only follow-up urological examination. In many cases the minute renal lesions accounting for the bacilluria will heal. In others, the microscopic foci will progress and the second clinical condition will develop: that of obvious renal involvement. In unilateral disease nephrectomy is indicated. In bilateral involvement the operation is contraindicated unless the involvement on one side is minimal and it is believed that removal of the badly infected kidney will materially improve the patient's general condition. In cases of renal tuberculosis complicated by extrarenal foci the more serious life taking lesions are granted precedence in the institution of treatment.

Intractable tuberculous cystitis, which has failed to show improvement over a reasonable period of time following nephrectomy will require diversion of the urinary stream by nephrostomy, cutaneous ureterostomy or transplantation of the ureter into the bowel. CLARENCE V. HODGES, M.D.

Ladewig, P., and Eser, S.: Malignant Tubular Adenoma in a Horseshoe Kidney; Its Significance with Regard to General Cancer Pathology. *J. Path. Bact. Lond.*, 1945, 37 405.

A case of malignant tubular adenoma arising within a horseshoe kidney is described by the authors and discussed with regard to its bearing on general cancer pathology. It is concluded (1) that the tubular adenoma ought to be regarded as a cancer matrix according to Cohnheim's theory of displaced embryonic tissue (2) that such displaced embryonic tissues as well as hyperregenerative hormonal and other tissue disturbances merely provide zones of potential growth instability (3) that in these zones "irritation" in the widest conception of the term may induce the fatal event of the cancer cell's birth as a somatic mutation and (4) that Cohnheim's theory and the "irritation" theory of cancer are not mutually exclusive but complementary.

The most widely accepted view is to regard the tubular adenoma as the result of an abnormality in fetal development at the time when the ureteric bud joins up with the metanephrogenic blastema and induces its differentiation and growth. In this stage certain elements of the tissues involved may fail to establish contact and become excluded from the co-ordination of further development. They are left free to unfold their remaining growth potency in unusual ways. This theory finds support in the authors' case from the peculiar combination of adenoma and horseshoe kidney. It is in fact generally agreed that horseshoe kidney is due to unusual growth impulses of the metanephrogenic tissues whereby the bilateral blastemas come into collision. In view of this the authors believe that they can accept the dysontogenetic nature of the tubular adenoma.

The tubular adenoma with its dysontogenetic origin is only a peculiar ground on which the malignant change has taken place. In the same way adenoma of the cirrhotic liver predisposes to malignancy as do adenoma of the prostate, certain forms of adenoma of the female breast and in rare instances adenoma of the thyroid gland. The cause of the formation of these different adenomas is the potentiality for prospective growth in existent embryonic tissue, hyperregenerative power in impaired tissue or even unbalanced hormonal stimulation. But none of these can be regarded by themselves as responsible for the induction of malignancy. This is shown by the uneven ratio between the frequent occurrence of adenomas and the relatively rare incidence of their malignant transformation. Moreover, in accordance with recent research on the subject we are justified in assuming that spontaneous cancer development is the result of an incidental and peculiar combination of various factors and influences, no one of which necessarily bears directly and specifically on the final result.

JOSEPH E. NARAT M.D.

Bowie, C. F., and Bora, E.: Primary Carcinoma of the Ureter. *J. Urol. Balt.* 1945 54 434.

Primary carcinoma of the ureter can still be considered a rare tumor although an increasing number of cases have been reported during the past decade. The total number of reported cases up to date is 175.

A case of carcinoma of the ureter complicated by severe infection which made the diagnosis more difficult, is reported. The operative technique is reported in detail because certain well recognized general surgical principles used in attacking malignant tumors anywhere else in the body were employed. No priority is claimed on the technique.

The principles carried out in this case were (1) opening of the peritoneal cavity for evidence of spread of the tumor (2) beginning dissection in healthy tissue above the tumor and (3) after the tumor was reached from above, dissection on the bladder side with the electrosurgical knife the whole

tumor being removed en masse. The kidney and remaining portion of the ureter were removed 4 months later. No evidence of tumor was present. Cystoscopy revealed a normal bladder with no evidence of recurrence.

JOHN E. KIRKPATRICK M.D.

BLADDER, URETHRA, AND PENIS

Krafka, J. Jr.: The Elasticity of the Human Urinary Bladder. *J. Urol. Balt.* 1945 54 438.

Incidental to studies made on the elasticity of the human aorta tests were run on the elongation of standard strips of urinary bladder. The technique used was that previously described in which increasing weights applied by the gravity pull on a carriage running on an inclined plane, exert a stretching force on the specimen and automatically record the relationships. The machine used was the Scott scigraph, which is commonly employed in fabric laboratories for measuring the elasticity and the tensile strength of thread.

It is common textbook knowledge that the detrusor serves as the principal agent in the emptying of the bladder. The urologists are also aware of the character of the pressure curves developed during the filling of the bladder. The commonly accepted value for emptying of the bladder is between 20 and 40 mm. Hg upon which is superimposed an additional volitional pressure produced by contractions of the abdominal muscles and the descent of the diaphragm which brings the total intravesicular pressure to approximately 74 mm. It is also observed that the pressure developed upon the addition of successive increments of fluid to the bladder volume is initially high but immediately levels off to fixed values proportional to the volumes prevailing. These reactions are commonly interpreted as due to balance in muscle tonus and the primary and secondary pressures are used as indications of hypertonicity or atony in various pathological states.

That such pressures prevail at other sites in the body has been well established. Hamilton, Woodbury, and Harper (1936) have made a study of cough and strain upon the blood pressure and upon the cerebrospinal fluid. Intracranial pressure may be raised 50 mm. Hg and there is one record of a blood pressure of 380 mm., due to strain.

Woodbury, Hamilton and Torpin (1937) in an analysis of intraterrine pressure have shown that 70 mm. pressure can be transmitted to the intragastric pressure and a like equivalent to the pregnant uterus.

Muschat (1935) noted a maximum of 60 mm. Hg pressure in the bladder of the tabetic with a paralyzed bladder wall, but an intact abdomen.

Another concept, of course, would need to be considered in a corollary to the one just developed namely the protection of the ureters against these high intravesicular pressures. Wellenweber has made a study of the pressure prevailing in the kidney pelvis at various intravesicular pressures. The for

mer is always lower than the latter. Thus at 120 mm. bladder pressure the pelvic pressure is 70 mm (water) at 350 it is 200 mm. This factor however is not so significant as the male one since the angulation of the ureter and the muscles of Waldeyer seem to provide a competent mechanism to prevent transmissal of the high pressures to the ureter.

That the musculature of the bladder does maintain a definite tonus is seen in the work of Holmes (1933) on the paralyzed bladder. Injury to the cervical, dorsal, or sacral cord results in an atonic bladder with a characteristic volume pressure relation on filling. His figure 2 shows a definite filling emptying curve which are reciprocals. His figure 7 shows one of the features noted by Langworthy, namely a sharp straight line rise followed by a rapid return to a base line in the course of a few minutes.

The effective stimulus to the emptying of the bladder is commonly assumed to be tension in the bladder wall. Free nerve endings and pressure corpuscles have been described but it is difficult to see how these can in one instance give the sensation of fullness then urgency and lastly pain. If the simple assumption is made that the tonus of the muscle develops and mediates the sensation a reasonable opinion is at hand. Hypertonic bladders empty at small volumes atonic bladders store tremendous volumes of urine either under pathological states or in the last months of pregnancy. Irregular contractions are seen normally at 400 c.c. volume and spontaneous contractions are noted after the steep parts of the cystometrograms curve. Curves are materially affected in the case of megacolon. How these factors could be applied to simple nerve endings or to pressure corpuscles is not clear but they would all be effective in muscle tone. Smooth muscle must act as a sensory ending to mediate its own reflexes either local or central.

The percentage stretch of standard strips of urinary bladder have been measured and Young's modulus calculated. The values range from 0.488 to 4.840 dynes per centimeter square $\times 10^6$.

The elasticity curves for the bladder have been compared to those for the aorta. The character of the curves is essentially different that for the aorta is a geometric curve, for the bladder a straight line curve. Within the limits of the test, the distensibility of the bladder is not checked by collagenous fibers such as are seen in the aorta.

Calculations are presented which equilibrate the stretching forces against manometric pressures as noted in the bladder by other investigators using the cystometer.

The theory of muscle function in the bladder is discussed. The primary function of bladder emptying for the detrusor is accepted. Secondary functions are 3 in number. The first of these is to provide an elastic membrane which can adjust bladder volume to bladder pressure. The second function is to provide a local elastic mechanism to adjust for the accessory pressures impressed on the bladder by cough and strain. The third considers the muscle as

a sensory organ for the mediation of the stress sense as a stimulus to voiding.

JOHN E. KIRKPATRICK, M.D.

GENITAL ORGANS

Heyman, A., Beeson, P. B. and Sheldon, W. H.: The Diagnosis of Chancroid. *J Am M Ass*, 1943 139 935

The methods employed at present for the diagnosis of chancroid are far from satisfactory. Current textbooks indicate that accurate diagnosis can be based on the clinical features, on the results of skin tests, or on the examination of stained smears. Most venereologists, however, know that each of these methods is subject to major limitations and errors. Actually at present the diagnosis is usually based on negative dark field examinations for spirochetes, and on clinical improvement after the institution of sulfonamide therapy. The establishment of reliable criteria for a positive diagnosis of chancroid would unquestionably be of value.

The present article is a report on the relative efficiency and usefulness of a number of diagnostic procedures in chancroid. These findings were obtained during an intensive study of a group of 125 patients suspected of having either chancroid or lymphogranuloma venereum.

A positive diagnosis of chancroid was made in 60 of them. Of the various methods, biopsy appears to be the most efficient single method of diagnosis and can be depended on to give a diagnosis in over 90 per cent of the cases in which it is applicable. Its use is limited to cases in which there are primary genital lesions. The removal of tissue for biopsy is in most instances a simple procedure, well suited to out-patient work. It is undesirable however in patients with small lesions because of the pain involved.

Cultural demonstration of the Dreyer bacillus can be accomplished in at least 75 per cent of all cases. The technique is not difficult and can be carried out by a competent technician. Culture is less likely to be successful in advanced lesions which are heavily contaminated with other bacteria. It is the only means of obtaining a positive diagnosis in patients with buboes but without primary lesions.

Diagnosis by means of direct smears of genital lesions is possible in approximately 50 per cent of the cases. This method has the advantage of simplicity and immediate diagnosis. Unfortunately, it is likely to be useless in advanced lesions, in which there is a heavy growth of other bacteria.

Autoinoculation has several disadvantages and does not take with sufficient frequency to make it of value in routine work.

The skin test for chancroid should never be relied on as the sole method of diagnosis although it may be of limited value as an adjunct to other procedures. In this group of 60 proved cases of chancroid, positive skin tests were found in only 46 (77 per cent). A further disadvantage lies in the fact that a positive skin reaction persists for many years after

GENITOURINARY SURGERY

an infection and therefore may not be significant in reference to the present illness.

The diagnosis of chancroid can in the majority of cases be established by suitable laboratory procedures.

JOHN E. KIRKPATRICK, M.D.

Lazarus, J. A.: The Significance of Spontaneous Hematuria Associated with Hypertrophy of the Prostate. *J. Urol. Balt.* 1945 54 531

Spontaneous hematuria is not infrequently an outstanding symptom among patients with prostatism and in certain instances it may be the chief complaint. The hematuria may vary from the presence of a few erythrocytes to the high power held (occult blood) to massive bleeding which may at times assume alarming proportions. It may be due to the prostate itself or to conditions which are extrinsic to the prostate, such as a cystitis secondary to and aggravated by urinary retention vesical renal, and nteral calculi tumors of the kidney, hydronephrosis and acute or chronic glomerulonephritis.

Since the hematuria is due so commonly to the prostate itself the urologist is frequently too casual in his examination after establishing the presence of a prostatic hypertrophy. If he then proceeds to perform a prostatectomy under the mistaken notion that the bleeding is due to the prostate, when in reality it is due to a coexisting renal tumor or some other condition which is unrelated to the prostate the outcome may be disastrous.

The author is, therefore, of the opinion that a complete urological study is indicated in every case of prostatic hypertrophy with hematuria.

Although many urologists have established an aversion for one reason or another to performing cystoscopic examinations upon their prostatic patients the author believes that cystoscopy should be carried out in these cases whenever it is technically possible. He believes that the cystogram and other indirect methods give inadequate information in addition to providing direct visualization of the vesical neck and lumen, cystoscopy gives the opportunity to catheterize the ureters and to take retrograde pyelograms in the event that no obvious cause for the bleeding can be found in the bladder or in the prostatic urethra.

FREDERICK LIEBERHAL, M.D.

Ferguson J. D. and Pagel W.: Some Observations on Carcinoma of the Prostate Treated with Estrogens, as Demonstrated by Serial Biopsies. *Brit. J. Surg.* 1945 33 132.

The authors carried out repeated biopsies by transurethral resection in a small number of patients with carcinoma of the prostate who had received estrogens for from 6 to 30 months. They distinguish two types of tumors those which arise in atrophic tissue in the posterior lobe of an otherwise normal gland and those which develop secondarily in a gland presenting benign hypertrophy.

The latter are usually latent and are discovered during routine microscopy of the enucleated gland. The former are more common, and have usually extended by the time the diagnosis is made. All of the material studied was composed of this type.

The authors took a careful history studied the urine for infection, tested renal function and repeatedly estimated the serum acid phosphatase. Anteroposterior views of the lumbar spine, pelvis and upper ends of the femurs were taken before and after treatment. Occasionally intravenous urograms were made. Four of the 5 cases were treated with stilbestrol and 1 was treated with dienestrol. The Gershom Thompson cold punch was used and biopsy specimens were taken from the posterior quadrant of the prostatic urethra immediately above the verumontanum. Coagulation hemostasis was used as frequently as possible.

The studies showed that in addition to an apparent reduction in the number of tumor nodules in the later sections there were cellular changes such as a diminution in the size of the nuclei measured quantitatively. There was a regressive change from a more cellular type of growth to a scirrhous form. In later sections there was again a diminution in the size of the cell nuclei with concentration of chromatin pyknosis and vacuolation of the cells.

DAVID ROSENBLUM, M.D.

Moschnt M.: Osteitis Pubis following Prostatectomy. *J. Urol., Balt.* 1945 54 447

The condition described is rather unusual. It was first presented as an entity by Beer in 1924. Since then an occasional report is found under the title of perostitis osteitis pubis or osteochondritis depending on which tissue seems predominately affected. Osteitis pubis appears as a distinct disease entity with a more or less characteristic course having no resemblance to an ordinary pyogenic or tuberculous osteomyelitis. It occurs in a small number of patients following operations upon the urinary bladder especially after prostatectomy. It is an inflammatory process of the bone which begins in the symphysis pubis and gradually involves the pubic ramal all the way down to one or both ischial tubercles. This inflammatory process spreads via the perineal to the variously attached muscles of the pelvis especially the obturator internus and levator ani keeping them in a spastic state. Aschner describes the characteristic clinical picture most graphically. The pain is intense and disabling in its effects. It forces the sufferer to lie down and when down he cannot get up nor turn from side to side, except in fear and agony.

The etiology of this condition is obscure the clinical picture with its symptomatology however is clear and follows a definite pattern. This pattern is practically identical in every case from the onset of the disease until clinical cure ensues the patient going through a period of physical agony lasting from 3 to 12 months. Two cases of osteitis pubis are described in detail and a summary of the few cases

from the literature with a discussion of the etiology, symptomatology, clinical findings, x ray studies, pathology, therapy and prognosis, is also included.

As in every other disease in which the sufferings of the patient are very great and prolonged, various therapeutic agents were tried. The most frequently used therapy was diathermy, baking and massage. None of these therapeutic procedures helped in the slightest. Most patients claimed that the diathermy aggravated their pain. X ray therapy was found useless. Application of a body cast is always suggested by the orthopedic surgeon who believes, and rightly so, that immobilization of the pelvis by a solid body cast will relieve the agony of pain. The patients, however, are very intolerant to a body cast.

It is the author's conviction that the disease is self limited and that surgical intervention is not required, but if an abscess does develop it should of course be properly drained. Penicillin (4,000,000 units) was used in case 1 without any subjective improvement whatsoever but it may have caused the absorption of the inflammatory lump near the scrotum. Sulfa drugs were tried without influencing the condition one iota. Any manipulative procedure to hasten the recovery is strongly contraindicated; it only aggravates the condition and stirs up local trauma, thus actually spreading the disease process and delaying the recovery. In a case reported by Barnes, the patient submitted to the "adjustments" of a chiropractor for several months. The "adjustments" were usually followed by chills and temperature as high as 105, and the patient was told that these reactions were supposed to be very beneficial. The majority of patients become so apprehensive that before long one gets the impression that they are greatly exaggerating their pain. The physician, therefore, is frequently tempted to force early activity and to encourage the patient to get out of bed and move about. The author found such forceful actions detrimental to ultimate recovery which was retarded for many weeks. He states that "whenever such activity is contemplated another x ray study will usually disclose that instead of improvement the process is at its worst and absolute rest is indicated."

Prognosis. The ultimate outcome in all cases is good. There is no spread of the disease to other structures or organs. The only complication is an occasional abscess formation with resituation after drainage. The only demonstrable scar is the complete ossification and ankylosis of the symphysis. This, fortunately, remains symptomless and the patient resumes his normal life.

JOHN E. KIRKPATRICK, M.D.

Bishop, P. M. F.: *Studies in Clinical Endocrinology: The Management of the Undescended Testicle*. Gay's Hist. Rep. Lond., 1945, 94, 12.

The author emphasizes the importance of close co-operation between the endocrinologist and the surgeon in deciding which form or combination of forms of treatment of undescended testicle will be

most effective and states that the decision should be based upon the individual situation present in each case. In his terminology the word "testicle" is used in its literal sense, i.e., a little testis. He describes the mechanism of normal testicular descent as occurring in three stages—abdominal, canalicular and extracanalicular—and extensively reviews the literature to discuss the various causes that have been postulated to account for incomplete descent. These are fetal peritonitis, defective development of the transversalis fascia, intercolumnar fascia, cremasteric fascia or muscle shortening of the cremaster muscle because of too powerful contraction, shortening of the processus vaginalis or of the cord structures, absence of the external ring and absence of the entire inguinal canal including both internal and external rings. Maldescent is often found to be associated with other physical and mental congenital deformities. The incidence of various positions of arrest, as described by various observers, is discussed.

Apart from the mechanical factors incident to body growth that play a role in the normal descent of the testicle, chorionic gonadotropin is a responsible endocrine factor. It causes enlargement of the testicle (indirectly a mechanical factor) stimulates the development of all the connective tissue elements associated with the testicle in its descent, and therefore elongates the cord structures and, by its action on the interstitial tissue of the testicle stimulates the secretion of androgen which "secondarily causes full development of the sexual apparatus, thus assisting the descent of the testicle" (Möllen, d'Armour and Gustavson quoted by the author).

A portion of the author's cases support the somewhat controversial view that androgenesis is affected by maldescent; the author is in full agreement with other writers that spermatogenesis is profoundly affected. He also believes that chorionic gonadotropin, although it may stimulate androgenesis, has no effect on spermatogenesis.

The evidence, both direct and indirect, for spontaneous descent of the testicle after birth is reviewed with the conclusion that it does occur.

Complications and sequelae incident to an descended testicle are pain, vulnerability to trauma, infection, hydrocele, torsion, psychological effects and malignant degeneration. However, endocrine or surgical procedures for inducing descent do not seem to diminish the possibility of malignancy.

From a surgical point of view cases may be classified into three groups.

Surgery of the atrophied testicle. I.e., removal to prevent possible malignant changes, orchidopexy for cosmetic and psychological reasons or either procedure to avoid the liability of trauma or torsion.

Surgery of the testicle with a deviated or impeded descent. In which the problem is purely a mechanical one and consists merely of obviating the difficulty caused by fibrous bands, adhesions, or bursal involvement. The best surgical results are obtained in

this group subject to the author's arbitrary qualification that the patient should not be older than 10 or 11 years

Surgery of the testicle with a delayed descent which is rendered difficult by the problem of preserving the blood supply of the testis

The optimal age for endocrine therapy must be determined because (1) overdosage at an early age may lead to premature puberty (2) the tissues are more responsive at the time of puberty and (3) the longer a testicle is left undescended after spermatogenesis begins, the greater the danger of irreparable damage first to the seminiferous tubules and later to the interstitial tissues. The criterion for dosage is the tendency toward excessive androgenic development. Most authors cited believe that endocrine therapy should not be continued for more than a few months. Abdominal testicles are not likely to respond to endocrine therapy. Canalicular testicles are more responsive in a high percentage of cases (60 per cent in the cases cited by the author) and extracanalicular testicles are difficult to evaluate and are therefore excluded from the author's analysis. Adverse effects of endocrine therapy employed in proper dosage were not noted by the author.

The conclusions derived from this study are (1) the extracanalicular testicle is a surgical problem (2) the canalicular testicle is primarily an endocrine problem and should be treated surgically only after endocrine therapy has failed or when there is a complicating mechanical impidence and (3) the abdominal testicle is unlikely to respond to either method of treatment. CLARENCE V. HODGES, M.D.

Vermaulen C. W. and Hagerty C. S.: Torsion of the Appendix Testis (Hydatid of Morgagni); Report of 2 Cases with a Study of the Microscopic Anatomy. *J. Urol. Balt.*, 1945 54 459.

The observation of 2 cases of torsion of the appendix testis by one of the authors in a limited and brief urological experience led the authors of this article to believe that the condition is perhaps more common than reports would indicate. Unless it is realized that the severity of the symptoms produced by torsion of this minute structure may be out of all proportion to the size of the appendix testis the condition may easily be mistaken for other intra-scrotal diseases, such as acute epididymitis, acute orchitis or torsion of the spermatic cord. In other instances a diagnostic mistake may be made because the initial symptoms sometimes focus attention upon the lower abdomen with little to indicate that the lesion is inside of the scrotum. This occurred in the first case described in this article in which the non-scrotal symptoms and signs confused the diagnosis to the extent that the condition was first called acute appendicitis.

Diagnosis of torsion of the appendix testis may be very difficult. In general the symptomatology is that of torsion of the testis. Both conditions occur chiefly in preadolescent or young adult males. In both attacks of incomplete transient torsion with

slight symptoms may have occurred previous to the acute severe episode. It has been said that torsion of the appendix testis does not result in inflammation of the scrotal skin, while torsion of the testis does produce this condition. However in both of the authors' cases marked erythema and edema of the skin of the affected side occurred.

Except by palpation of the spermatic cord and the scrotal contents it will be impossible to distinguish between torsion of the testis and torsion of the appendix testis. If there is a tender mass anterior to the testis it may be either the epididymis of a rotated testis or a twisted appendix testis. Differentiation can be made only by careful examination.

The epididymis of a rotated testis would extend down the entire length of the testis while an anterior mass due to torsion of the appendix testis would be limited to its upper pole and be movable upon the testis.

Very little information could be obtained from articles on torsion of the appendix testis regarding the usual histological appearance of this small structure. Furthermore textbooks on histology give descriptions that are not entirely in accord. For example Bailey's *Textbook of Histology* states that the appendix testis (hydatid of Morgagni) is a vesicular structure lined by simple columnar epithelium surrounded by vascular connective tissue. Maximow and Bloom say that the appendix testis is a small nodule consisting of vascular connective tissue and lined with columnar, sometimes ciliated epithelium. Lowley and Kirwin state that the hydatid of Morgagni is a pedunculated pear-shaped sac from one-eighth to one-third inch long its free extremity dilated and containing a colorless fluid. The lack of information on the histological structure in case reports of torsion of the appendix testis and conflicting reports on the histological picture as described in textbooks prompted the study of 28 appendices testes from the standpoint of their gross and microscopic anatomy.

Grossly the appendix testis is a small ovoid or flattened tab of pale gelatinous tissue varying from 1 mm. to 1.0 cm. in diameter. It is attached to the tunica albuginea by a short pedicle. In at least half of the specimens examined, the pedicle was sufficiently long and narrow so that it could have undergone torsion.

Microscopically the appendix testis was made up of loosely arranged connective tissue which was moderately rich in blood vessels. In the connective tissue of some specimens were seen spaces of varying size apparently lined with endothelium and frequently containing a precipitated albuminous material. These structures had more the appearance of lymph channels than that of remnants of epithelial lined tubules. Most of the specimens had a few scattered leucocytes in the tissues. All of the appendices testes were covered by tall columnar epithelium which was sometimes ciliated and associated with the columnar epithelium were a few

round pale mucous secreting cells. This epithelium became continuous with the very flat columnar epithelium of the tunica albuginea.

Epithelial inclusions were present in 2 of the 28 specimens. The epithelial covering of the appendix testis and the lining of the epithelial inclusions closely resembled the lining of the distal end of the fallopian tube of the female. This would be expected because the appendix testis is derived from the cranial end of the muellerian duct which in the female forms the fimbriated end of the fallopian tube.

JOHN E. KIRKPATRICK, M.D.

Francis, R. S.: The Status of Hormonal Bioassay in Malignant Disease of the Testicle. *Brit. J. Surg.* 1945 33 175.

With the exception of the seminoma, which is considered to be derived from the spermatogenic tubule cells, testicular tumors have come to be denoted by the name "teratoma" and other names depending upon the type of tissue which predominates have been applied to this group, such as chorioepithelioma, embryonal adenocarcinoma, teratoid carcinoma with cancerous elements and "mixed adult types with carcinoma."

In 1930 Zondek discovered that malignant tumors of the testis caused the urine to give a positive Aschheim-Zondek pregnancy test. In the test and in a male's ovary three results were obtained: (1) ripening of the graafian follicle, (2) hemorrhage into the cyst, and (3) gross enlargement of the uterine horns. It is now understood that the hormone output tends to vary indirectly with the degree of cellular maturity of the tumor. However, one cannot foretell the histological type of tumor from bioassay of the tumor alone. There is a correlation between the hormone levels and the clinical course and consistent high levels usually lead to a fatal outcome. It must be pointed out that many negative assays have been associated with malignancy.

The test is a valuable indication of the effectiveness of treatment. When the hormone output falls to 400 mouse units per liter within two weeks of the completion of treatment, the prognosis is good. A rising or stationary titer after treatment is a bad omen. It is due to local recurrence or metastasis.

The test has various limitations such as variations of methods of extracting urine, the numbers of mice used per level of assay, variations in the interpretation of ovary changes, and the original names of tissues present which give rise to increased hormone output. In the present stage of the test, the assay of the urinary hormones is not a basis for attempting to foretell the histological type of tumor. There is some evidence that the seminomas produce only follicle stimulating hormone and that embryonal teratomas produce both follicle and lutein stimulating hormone (chorionic hormone). Simple orchiectomy is the operation of choice, followed routinely by irradiation, especially of the aortic glands, whether or not metastases are suspected. This routine would cause fibrosis of the lymph-

drainage system and prevent the spread of a possible local recurrence subsequent to treatment.

There is need for a standardized technique of extracting hormones taking 24 hour specimens, making routine assays before treatment and serially during and after treatment using more than 1 mouse per level of concentration, making histological section of the mouse ovary after the test, and making bioassay of the tumor with determination of the two hormones separately. While the range of titer is characteristic for the three main groups—the embryonal teratoma, the seminoma, and the mixed adult teratoma—the precise pathology of a particular tumor cannot be predicted from the preoperative urinary assay, although low levels suggest either seminoma or the mixed adult type. Follow up tests should be performed for at least 10 years after treatment—first weekly then at less frequent intervals, and then at six month periods.

DAVID ROSENBLUM, M.D.

MISCELLANEOUS

Borhans, R. A.: Treatment of Orchitis of Mumps. *J. Urol.*, Balt., 1945 54 547

The so-called entity "orchitis of mumps" is a monomer. It has been considered an infection or inflammation involving the testes. In a naval hospital it was observed that the patients do not develop primarily an orchitis of mumps but an acute hydrocele around the testicle which causes a strangulation of the testicle, in contradistinction to a slow forming hydrocele. This acute process causes strangulation, acute inflammatory edema, and ultimate fibrosis and atrophy of the testes. These facts have been substantiated at operation.

During the acute scrotal involvement of mumps there is a high fever and leucocytosis, but after from 12 to 24 hours the damage has been done even though the temperature subsides.

If a small scrotal incision is made during the acute orchitis an acute hydrocele is encountered in which the fluid in the tunica vaginalis is under extreme pressure and has a viscid yellowish color. After drainage no other treatment is necessary and the fever stimulates a crisis of pneumonia. If drainage is delayed, the tension in the hydrocele lessens, the testicle becomes blackish and the testicular tissue presents bulbous edema and inflammation.

In early cases of orchitis of mumps incision of the acute hydrocele with removal of the drain in 48 hours is indicated and in late cases, the tunica preputia and albuginea should also be drained. Pentothal sodium anesthesia has proved most satisfactory but local anesthesia has not, as the involved area is tender.

DAVID ROSENBLUM, M.D.

Cook, E. N., and Keating, F. R. Jr.: Renal Calculi Associated with Hyperparathyroidism. *J. Urol.*, Balt., 1945 54 55

Since only 4 cases of proved hyperparathyroidism were observed at the Mayo Clinic from 1929 to

1933 and since this incidence was at a variance with the experience of Albright and his associates who accumulated 67 cases in 10 years the authors made a deliberate search for the disease in the material of the Mayo Clinic from January 1933 to July 1934. They discovered 18 cases. In 4 of these the patients had only the classical disease of the bone which is observed in hyperparathyroidism while in 14, associated renal calculi were demonstrated and evidence of disease of the bone was minimal or absent.

During this same period 850 cases of urinary calculus were seen. Although this would indicate an incidence of 2 per cent of hyperparathyroidism in cases of urinary calculus, the authors believe that this figure is far too low since only a relatively small proportion of these patients were subjected to a sufficiently careful metabolic study to exclude hyperparathyroidism completely.

A hyperfunctioning parathyroid adenoma was demonstrated in all of the 18 cases of hyperparathyroidism.

The frequency with which the diagnosis is made correctly will vary directly in proportion to the thoroughness with which a search is made for the disease. The greatest opportunity for establishing such a diagnosis will appear in cases of multiple or recurrent calculi. Approximately 10 per cent of urinary calculi will recur following surgical removal. The authors believe that this percentage can be reduced appreciably if the presence of hyperparathyroidism is carefully excluded.

The diagnostic criteria of hyperparathyroidism are hypercalcemia, hypophosphatemia, hypercalciuria and hyperphosphaturia. Frequently repeated examinations are often necessary to establish a diagnosis. Roentgenological findings may be helpful in cases with associated disease of the bone. In cases in which there is uncertainty the authors frequently rely upon quantitative determinations of the calcium in the urine while the patient is on a diet low in calcium.

When calculi are present the symptoms are identical with those occurring with calculi due to other causes. In all such cases a detailed urological study is indicated. It is usually advisable to remedy the hyperparathyroidism first, as subsequent calculi may develop rapidly. It may however be necessary

to take care of the urological problem first because of its acute character.

Many forms of medical therapy have been tried. Diets low in calcium are unlikely to alleviate the renal symptoms and subject the skeleton to the hazard of demineralization. Diets high in calcium increase the tendency toward stone formation. Acidifying drugs such as ammonium chloride are of little avail because the increased solubility of calcium in an acid urine is counteracted by a resulting increased output of calcium in the urine.

The treatment of hyperparathyroidism is surgical, by removal of the offending parathyroid adenoma, or when primary hypertrophy of all parathyroid tissue is involved, by subtotal resection of the parathyroid glands. The urinary calculi already present usually remain unchanged, but in a few instances they have eventually dissolved.

FREDERICK LIEBERMAN, M.D.

Hellendall, H.: Experimental Transmission of Lymphogranuloma Venereum Virus through the Placenta. *Am J Surg* 1945 70 320.

Since it is known that the virus of lymphogranuloma venereum can invade the blood stream, the author attempted to determine if lymphogranuloma venereum can be transmitted through the placenta to the fetus. In 1936 a positive Frei reaction in a 14 day old infant was observed by Dick. The author's studies in 1945 showed that the antigen prepared from the fetal brains of mice gave positive intradermal reactions.

The present work was concerned with three questions: (1) Can the previous work with mice be confirmed with Frei tests in human beings? (2) Can the initial elementary bodies of the lymphogranuloma virus be found in smears and tissues of the fetal brain? and (3) Will antigens from the brain of an intracerebrally infected mouse give a positive Frei test when injected into the skin of an apparently healthy offspring of an infected mother?

The conclusion was reached that lymphogranuloma virus is transmitted through the placenta to the newborn before delivery. The clinical question as to whether there is any occurrence of congenital lymphogranulomatosis in human beings should be studied with a great amount of statistical material.

DAVID ROSENBLUM, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Meyerding, H. W.: Chronic Sclerosing Osteitis.
West. J. Surg. 1945 53: 413.

The patients included in this series of 80 cases of chronic sclerosing osteitis were of the average age of 25 years, appeared to be in good health, and were not disabled. The preoperative clinical laboratory findings of the blood and urine were of little value in the diagnosis. Trauma may have been an inciting factor of the condition in 31.2 per cent of the cases.

The outstanding symptom was persistent localized pain in 93.8 per cent of the cases. In 67.5 per cent this was associated with swelling. The duration of the symptoms averaged 1.4 years. Sixty five per cent of the patients were males. In 92.5 per cent of the cases the lesions were located in the lower extremity, 50 per cent occurred in the middle third of the shaft of a long bone, 90 per cent occurred in the shaft of the tibia or femur. Patients aged from 10 to 30 years comprised 69 per cent of the total number.

The roentgenograms revealed dense spindle shaped cortical regions of sclerosis that involved the shaft of the long bones. Translucent regions, small and round, or oval, were often visible. These regions sometimes showed staphylococci on bacteriological examination of the material removed at operation and have been looked on as foci of infection producing the sclerosis.

The treatment is surgical excision and the results obtained are good.

Compere, E. L., Schulte, W. J., and Cattell, L. M.:
The Use of Penicillin in the Treatment of Acute
Hematogenous Osteomyelitis in Children. *A. A. Surg.* 1945 1: 954.

This is a report of 12 consecutive cases of acute hematogenous osteomyelitis in children ranging from 3 to 12 years of age which were treated with penicillin.

Ten of the cases had been resistant to sulfonamides and only 4 required surgery. There were no deaths.

The authors state that penicillin appears to be more effective in the treatment of acute hematogenous osteomyelitis than any other therapeutic agent including the sulfonamides.

Adequate doses of penicillin, from 15,000 to 30,000 units administered every 3 hours day and night, may not only cure the initial infection but prevent spread to other bones and in most of the cases they make surgery unnecessary. If the treatment is started late, bone damage may call for late surgery.

Medical care must not be neglected in these cases. The fluid balance of the body must be maintained with normal saline solution, glucose, blood or plas-

ma. Splints, plaster casts or traction are used when indicated.
DANIEL H. LEVENTHAL, M.D.

Mardettoll, O. R.: Osteoarticular Lesions in Brucellosis (Lesiones osteoarticulares de la brucelosis). *Rev. Méd. Rosario* 1945 35 8.

Osteoarticular lesions observed in the course of evolution of brucellosis are characterized as is the disease itself by clinical manifestations of various forms. There are many transitional forms between monoarticular and generalized polyarticular lesions. From the physiopathological viewpoint the syndrome may be divided into two classes: (1) allergic manifestations of the early periods of the disease, chiefly in the form of hyperergic reactions of mesenchymal osteoarticular tissues and (2) processes confined to one articulation or one osteoperiosteal segment, which are the sequelae of the accumulation of specific bacilli. Only the last mentioned group represents the authentic lesions of brucellosis.

Two groups of osteoarticular lesions may be distinguished: osseous and articular.

Osseous lesions in brucellosis are relatively rare and occur approximately in 5.8 per cent of all patients if the spinal column is excluded. From the anatomoclinical point of view two conditions may be distinguished, osteoperiostitis and osteomyelitis. The first mentioned condition may assume a simple form of reaction or may develop into a suppurative lesion. A simple reaction is characterized by pain and roentgenological findings, while suppurative conditions have a chronic evolution. Osteomyelitis may appear in an acute or chronic form. Osseous lesions produced by brucellosis are relatively benign and show a rapid tendency toward regression and reparative processes. Various types of chronic osteomyelitis such as pseudotumoral, condensing, or inflammatory have been described. The diagnosis may be difficult if the involvement of the bones appears in very early stages of the disease.

Articular lesions appear in approximately 40 per cent of all cases of brucellosis. They may assume two forms: pseudorheumatism and arthropathies. The first mentioned condition appears nearly exclusively in the acute periods of the disease and may be interpreted as an allergic reaction of the articular mesenchyma to the infection and the toxic effects of brucellosis. The condition may be monoarticular or polyarticular. Arthropathies may be classified as synovitis, arthritis and osteoarthritis. Brucellosis shows a preference for primary localization in the osseous epiphyses, invading the articulations secondarily. As a rule large articulations are affected. Generally articular lesions of brucellosis are relatively benign and no important anatomic or functional sequelae are recorded. Occasionally an ankylosis may develop. Involvement of the spine has been found in as many as from 50 to 75 per cent of all

autopsies of patients suffering from brucellosis. As a rule spondylitis appears in relatively late stages of brucellosis. Various distinct processes develop within the spinal column viz. degenerative destructive and reparative. The process may involve intervertebral discs. Three forms may be distinguished (1) generalized or circumscribed spondylitis, (2) a condition resembling Pott's disease and (3) a spondylarthritic form. The symptoms are those of an involvement of the spine due to any cause namely pain muscular contractures deformities, and the formation of abscesses. There are no characteristic roentgenological signs. Frequently osteophytic and exostotic formations are visible. The process is relatively benign.

The treatment should be directed toward the etiology. Spondylitis requires immobilization on Bradford's frame or in a plaster-of-Paris cast. Albee's operation may be considered if spondylitis is circumscribed and if an intervertebral disc is involved. Social economic and personal problems should be taken into consideration when a prolonged immobilization is contemplated.

JOSEPH K. NARAT, M.D.

Soule, A. B., Jr. Mutational Dysostosis (Cleido-cranial Dysostosis). *J Bone Surg.* 1946 28: 81

Mutational dysostosis frequently transmitted by parents to offspring is characterized by multiple variable skeletal anomalies. The most prominent and frequent of these are aplasia of the clavicles, irregularities of dentition and structural abnormalities of the jaws, skull, vertebrae, pelvis, femora, scapulae, metacarpals, metatarsals and phalanges.

A careful survey of the English literature establishes that the first authentic case was reported in 1870 and since then the author collected cases total 323 of which 198 are familial, involving 52 families. About half of the patients are males. Geographic distribution represents every continent. In the cases with a hereditary background there has been transmission by male and female to a nearly equal degree. The condition may appear in several successive generations and then be lost and apparently not reappear in subsequent generations.

The etiology is associated with a defect in the parental germ plasma so that the anlage of the affected bones, both membranous and of chondral origin is thought to be faulty. Various other theories and observations are presented, none is conclusive. Most of the skeletal defects found in mutational dysostosis are present at birth but may not be obvious until the child develops. The possible variants are so great that no one abnormality is characteristically found in all cases.

A comprehensive discussion of the abnormalities possible in this condition is given and illustrated with photographs and roentgenograms. The dental defects with their complications are most troublesome, and treatment in general is directed toward the alleviation of symptoms. Six cases, two pairs of which were related are presented fully and demon-

strate the variability of the defects. The multiplicity of defects which may occur in this condition makes it rational that the term cleidocranial dysostosis be replaced by the more accurate and descriptive term mutational dysostosis.

FRANCIS E. BRENNECKE, M.D.

Smith F. M.: Late Rupture of the Extensor Pollicis Longus Tendon following Colles' Fracture. *J Bone Surg.* 1946 28: 49

Late rupture of the extensor pollicis longus tendon following Colles' fracture is an unusual complication which results in disability that may be relieved only by operation on the tendon. The author has observed and treated 5 cases of this type on the Fracture Service of the Presbyterian Hospital, New York. These cases are described in detail with illustrations.

The complication has been previously described in the literature and the incidence was given as 1 to 270 Colles' fractures. At the Presbyterian Hospital, New York, the incidence was 1 to 268. The majority of the ruptures have occurred in the left wrist and 4 of the 5 cases reported were in the left wrist. The complication is more frequent in females (60 per cent) and all 5 of the reported cases were in females. The tendon rupture is more common after the age of 30 years and the age incidence in this series was from 21 to 65 years of age.

The cause of the rupture has not been definitely established but it probably follows rather late after acute or chronically repeated trauma. Factors such as partial laceration of the tendon by a spicule of bone and trauma from forceful reduction of the fracture have been considered. Numerous cases of rupture have been reported when the fracture was minimally displaced or unrecognized and no reduction had been done. In 2 of the 5 cases reported the patients sought treatment late that is 19 days and 2 months respectively after their falls. Neither patient suspected she had a fracture and since in neither case had the fracture been reduced or the wrist splinted it was impossible to consider rough manipulation or faulty splints as a predisposing cause of the tendon rupture. In the 3 other cases the latent period of tendon rupture was 25 days, 27 days, and 6 weeks. From the operative and pathological findings in the 5 cases it is the author's belief that in rupture following Colles' fracture the cause is an aseptic necrosis due to interference with the blood supply of the tendon at the distal end of its groove on the radius.

There are no symptoms prior to rupture which would lead the surgeon to suspect a degenerative process in the tendon. A few patients describe a single sharp pain when the tendon ruptures but most of them describe what they call a sensation of something giving way or a snap on the back of the wrist followed by inability on their part to straighten or to lift the thumb actively. They may also note difficulty in picking up small objects such as pins. No subjective sensory changes are noted.

Physical examination reveals first, a thumb that droops in its entirety, and second, partial flexion of the distal phalanx. There is inability to elevate the thumb actively to the same level as the other metacarpals, and it is impossible for the patient to extend the distal phalanx actively against resistance although this can be done passively. The ulnar border of the anatomical snuffbox is characteristically absent. Occasionally the swollen degenerated end of the distal portion of the ruptured tendon can be felt beneath the skin and subcutaneous tissue as a small bump. There is no loss of skin sensation over the superficial distribution of the radial nerve.

The site of rupture in the extensor pollicis longus tendon is usually at the level of Lister's tubercle on the dorsum of the lower extremity of the radius. The distal portion of the ruptured tendon is usually drawn downward and the proximal portion usually retracts upward to the upper edge of the dorsal radiocarpal ligament or even more proximal to this. As much as 5 cm. sometimes separates the two tendon ends. Adhesions occur and the groove on the dorsum of the radius through which the tendon passes becomes obliterated. A specimen stained with Scharlach R showed the presence of fat between the tendon fibers.

In considering the operative repair of this condition, the author emphasizes that the extensor pollicis longus tendon has a dual function. Extension of the distal phalanx upon the proximal phalanx at the interphalangeal joint is probably the less important half of this tendon's function. Drooping of the thumb as a whole which is observed in this complication, is due entirely to the loss of the oblique pull of the tendon. Any operative procedure designed to restore full function must therefore restore the oblique pull. Following experiences of the first 3 cases the author recommends suture of the distal end of the extensor pollicis longus to the extensor carpi radialis longus by end-to-side suture. Following this, the tendon of the extensor pollicis brevis is also drawn over and sutured by a side-to-side suture. The first hookup gives the lift to the thumb and the extensor pollicis brevis adds extension to the distal phalanx. The ideal method of repair by resuturing the tendon ends or by implantation of a free tendon graft is prevented by the adhesions that are present even if they were broken it would result only in bleeding that would produce more and denser adhesions. During postoperative immobilization the tendon would "freeze" and become nonfunctioning. Upon exploration and repair of the tendon the superficial branch of the radial nerve should be isolated and protected because damage to it may lead to distressing numbness of the dorsum of the thumb.

Following operative closure the hand, the wrist and forearm should be immobilized in a volar molded plaster splint in slight cock-up position with the thumb fully extended and elevated. The splint may be removed at the end of 30 days and the patient encouraged to begin moving the thumb very gently in flexion and extension. He should then be advised

to remove the splint 3 or 4 times daily for exercises and for hot soaks. Usually at the end of 3 or 4 weeks it is possible to discard the splint completely at which time the exercises are increased and the patient is encouraged to begin mild active use of the thumb.

In all of the 5 reported cases the patients showed improvement in function and use. The best follow-up results from a functional standpoint were found in the cases treated by the operation proposed by the author.

CHARLES A. WATKINS, M.D.

Guri, J. P.: Pyogenic Osteomyelitis of the Spine. Differential Diagnosis through Clinical and Roentgenographic Observations. *J. Bone Surg.* 1946, 28, 90.

This article is based on 45 cases of pyogenic osteomyelitis of the spine. In order to arrive at the correct diagnosis it was necessary to be very careful in the differential diagnoses. Some of the conditions considered in these diagnoses were acute appendicitis, the meningial syndrome, and the back pain syndrome. The latter was divided into an acute form (16 cases) the subacute form (7 cases) and the insidious form (19 cases). Here the diagnosis rested between the differentiation of pyogenic infection from tuberculosis. The site of the pyogenic infections varied they involved the spinous articular process the transverse process, or the laminae. When pyogenic osteomyelitis involves the vertebral body it may be divided into the localized or diffuse form. When the diagnosis is tuberculosis, in adults, areas of increased density are not frequently found in the roentgenograms of living subjects except when there have been secondary infections huge sequestra, or sudden collapse. There is a definite increase of density and sclerosis in pyogenic spondylitis thus these features are diagnostic and permit the differentiation between tuberculosis and pyogenic spondylitis. RICHARD J. BENNETT JR., M.D.

Hatcher G. H.: The Pathogenesis of Localized Fibrous Lesions in the Metaphyses of Long Bones. *Ann. Surg.* 1945, 12, 1016.

Because of the various secondary characteristics which are prominent in the course of localized benign fibrous lesions of bone, a variety of lesions have been described under various diagnoses. Philip and Burman and Sinberg described the lesions as solitary xanthomas, while Geschickter and Copeland called them variants of solitary bone cysts or benign giant cell tumors. Phemister described some localized non-suppurative lesions of bone as fibrous osteomyelitis. Some of these would now be included in the lesions described as osteoid osteoma. In 1932 Jaffe and Lichtenstein demonstrated the various stages in the development of solitary fibrous lesions of bone and interpreted them as benign tumors formed from mature marrow connective tissue. These were called nonosteogenic fibromas of bone.

The author reports on 51 lesions found in 45 patients and demonstrates the clinical, roentgenologic

ical, and pathological findings in the various stages of the development and regression of the lesion. There were 38 males and 17 females. Five patients had multiple lesions. The lesions had their inception during the period of longitudinal growth. All of the lesions were in the long bones of the lower extremities. Jaffe and Lichtenstein found 1 lesion in the distal end of the ulna. All of the lesions were situated in the metaphysis or adjacent shaft usually eccentric and abutting on the cortex.

The symptoms are usually mild and consist of intermittent moderate pain often referred to the adjacent joint, and local tenderness.

Roentgenographically there is a limited area of reduced density in the metaphysis close to the epiphyseal disc which in later cases elongates and has a sclerotic margin, usually scalloped which gives the appearance of loculation. Later cases may show periosteal reaction.

The pathological appearance varies somewhat with the age and activity of the lesion. Fibrous connective tissue is the basis of the lesion in all stages. The recently formed focus shows a relatively cellular fibrous tissue with scattered multinucleated cells. The older lesions show fibrous tissue arranged in strands and whorls. Lymphoblasts are found scattered through the fibrous tissue. Lipoid filled macrophages are often present grouped or scattered. The lipoid deposition is evidence of chronicity. Concomitant epiphyseal disorders were observed in 14 cases. Spontaneous healing of the fibrous metaphyseal lesions was usual. In only a few cases was surgical eradication necessary for the relief of pain. The etiology of metaphyseal fibrous defects is obscure.

DAVID H. LEVINTHAL, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Robertson, L. M. and Barron J. N.: A Method of Treatment of Chronic Infective Osteitis. *J. Bone Surg.*, 1946, 28, 19.

The authors' treatment of chronic infective osteitis is based on the principle of extensive excision of all diseased tissues including skin, deep scars, and infected bone, and the replacement of soft tissue defects by muscle and skin flaps, and of bone defects by bone transplants.

This procedure may require two or three operative stages. In the first stage all of the diseased tissue is excised and a split skin graft is applied to the wound surface. In the second stage there is a plastic repair of the soft tissues. The original split skin graft is removed and the area is covered by a skin and subcutaneous flap, muscle being included where necessary. Stage three consists of repair of the bone graft. In some cases the second and third stages may be combined. An interval of 4 weeks is suggested between the first and second stages and one of at least 8 weeks between the second and third stages. In some cases the full diameter of the shaft of the bone may be involved.

Several diagrams, photographs, and roentgenographs are included in the original article. The details of the operative care in the three stages are discussed at length. A word of warning is given that this is not an undertaking to be lightly embarked upon by the operator.

RICHARD J. BROWETT JR., M.D.

Starr D. E.: Congenital Absence of the Radius. *J. Bone Surg.* 1945, 27, 578.

Three cases (involving four limbs) of congenital absence of the radius in its various aspects have been seen by the author.

The most interesting was a bilateral case with congenital absence of the radius, the thumb and the first metacarpal bones. The 3 other patients showed partial or complete absence of the radius and absence of some of the carpal bones. This deformity is disabling and very unsightly.

A three stage procedure is carried out whereby skeletal traction is applied, ulnar osteotomy is performed, and a fibular transplantation is carried out. The end result is particularly good in that it allows forearm rotation and wrist motion when part of the radius is present, and presents an extremely improved appearance.

RICHARD J. BROWETT JR., M.D.

Aitken D. M.: Late Results of Albee Fixation of Tuberculous of the Spine. *Proc. R. Soc. M., Lond.* 1945, 38, 685.

The author states that during the past 40 years the treatment of tuberculosis of the spine has passed through two phases and entered the third. The first phase consisted of fixation of the affected joints on a controlling splint until all pain and swelling had disappeared and the patient's condition was thriving. The second phase may be said to have begun about 1911 and was first applied in Robert Jones' practice, mainly to tuberculous disease of the spine. It consisted in the addition of a bone graft with the object of securing extra-articular fixation and bridging the diseased area to secure more complete fixation.

The third or present phase is based on the extraordinary results which followed successful employment of the Robertson-Lavalle technique which is briefly outlined. This procedure consists of drilling tuberculous foci which are believed to contain some defensive substance which cannot escape into the general circulation on account of the constriction of the issuing capillaries by the tough capsule about the focus. Drilling into the focus is supposed to let this mysterious substance out into the systemic circulation. Only young foci are drilled. These show on the x ray as faint blurred areas of decreased density.

Use of the procedure is said to be followed by marked improvement in the well-being of the patient. Pain usually disappears quickly and the degree of sepsis is lessened.

VERNON C. TURNER, M.D.

Dislocation of the knee joint is frequently associated with peroneal nerve injury and rupture of the popliteal artery. The latter complication occurred in 10 legs which had to be amputated because of subsequent gangrene.

Thirty-two patients were unconscious for periods varying from a momentary lapse to several days. They were thrown in a vertical direction up to 115 feet and horizontally up to 200 feet.

The first aid treatment of solid blast injuries is primarily devoted to saving life, i.e. the treatment of shock, splinting of the injured parts and evacuation to safer places for definitive medical care.

The final management of these patients follows along well known lines. It is noteworthy that skeletal fixation devices (Roger Andersen Stader) were found to delay union and cause osteomyelitis around the pin holes. Sailors who were in their bunks at the time of the explosion suffered the least injuries.

In conclusion 13 case histories are described in detail.

GEORGE L. REISS, M.D.

ORTHOPEDICS IN GENERAL

Bateman J. E.: A Universal Splint for Deformities of the Hand. *J. Bone Surg.* 1946 28: 169.

A splint is presented for the maintenance of adequate immobilization of the wrist and fingers deformed as a result of nerve injury. This apparatus prevents overstretching, eliminates undue pressure on devitalized tissues and avoids stiffness due to prolonged immobilization. Stiffness is avoided by re-



Fig. 1. The splint is applied in a paralysis of the median nerve, requiring finger and thumb correction. Note that the thumb may be pulled from the position of adduction.

moving the device twice daily, and actively and passively moving the immobilized parts. This process is made very simple by the construction of the universal splint.

The splint consists of a universal holder to which accessories consisting of steel arches (0.125 by 0.025 inch) twisted in a coil are attached. The spring arches are held on the holder by studs on fixed swivels.

The splint can be used as a posterior splint, as an anterior splint, and as a combination splint.

GEORGE L. REISS, M.D.

SURGERY OF THE BLOOD AND LYMPH SYSTEMS

BLOOD VESSELS

Gross, R. E.: Surgical Correction for Constriction of the Aorta. *Surgery* 1945 18 672.

Researches on dogs were carried out which indicated that the aorta could be completely transected and a normal vascular pathway reconstructed.

Two case reports are included in which the constricted area of the aorta was resected. In the first case the patient died of cardiac dilatation said to be due to the fact that the blood was allowed to re-enter the great vascular bed in the lower part of the body too rapidly. In the second case a 12 year old girl was studied and prepared for operation. The operation was carried out successfully in June 1945. The constricted area was resected and a satisfactory end-to-end anastomosis was completed. The patient made an uneventful recovery.

It was interesting to note that the blood pressure in the lower extremities came up to the normal level over a period of several days, while the hypertension in the upper extremities gradually decreased over a number of days. RICHARD J. BURKETT JR. M.D.

Paul, M.: The Surgical Treatment of Traumatic Aneurysms. *Br. J. Surg.* 1945 33 13.

The surgical treatment of large aneurysms is attended with difficulty and danger and the successful management of such cases demands a high degree of technical skill together with a proper appreciation of the problems of this branch of surgery. The author presents detailed reports of 8 cases. These indicate how problems have been met in individual instances that are not so common as to be within the experience of most surgeons.

A brief history of the surgical treatment of aneurysms is presented. The risk of gangrene of a limb following an operation in which the blood flow through the main artery has been obstructed by the operative procedure should be minimized as far as possible. If the arteries distal to the aneurysm exhibit a normal pulsation it is clear that most of the blood is still travelling through the main artery. In the traumatic cases the aneurysm is likely to be saccular and suitable for treatment by the restorative endoaneurysmorrhaphy method of Matas which carries almost no risk of interference with the main circulation through the limb. If on the other hand there is no pulse in the arteries distal to the aneurysm, it is clear that the circulation is being carried on mainly by collateral vessels and Matas advocates that the deficiency of the collateral circulation be estimated by the following method.

The limb is blanched by elevating it and by the application of a firm elastic bandage. The main artery is now compressed above the aneurysm. The elastic bandage is removed and the limb lowered. If the collateral circulation is efficient, there should

be a blush in the blanched limb within 3 minutes. If the collateral circulation is deficient, it can be improved by removing the sympathetic vasomotor control to the limb either by the operation of sympathectomy or more temporarily by the injection of the sympathetic field with novocain.

In conclusion the author notes that among the 8 cases of aneurysms described, the aneurysm was traumatic and saccular in 4 and the arteries distal to the aneurysm exhibited almost normal pulsation. In these cases the Matas operation for reconstructive endoaneurysmorrhaphy proved thoroughly practicable, the patient being cured by the operation.

In 3 cases the aneurysm was traumatic and fusiform. The arteries distal to the aneurysm showed no pulsation. Matas obliterative endoaneurysmorrhaphy served, however, to cure these patients of their aneurysms. In 1 case which unfortunately proved fatal, the aneurysm was due to the rupture of an arteriosclerotic calcified vessel. In this case the aneurysm had caused gangrene of the foot, which necessitated a disarticulation through the hip joint.

HAROLD F. THURMON, M.D.

Burton, R. W. and Collier, F. A.: Surgical Treatment of Long Standing Deep Phlebitis of the Leg. A Supplementary Report. *Surgery* 1945 18 663.

In the group of cases studied the long standing deep phlebitis of one or both lower extremities had its onset from 6 months to 30 years previously. Ligation of the femoral vein was carried out in individuals who had pain or disability resulting from chronic deep thrombophlebitis. The authors suggest that ligation of the femoral vein should not be carried out beyond the age of 55 years because of the advanced arterial diseases. Superficial varices were treated by ligation before the femoral vein ligation was carried out. The injection method of treatment of varicose veins was not used before, during, or after femoral ligation and none of the patients had received lumbar sympathetic block before during or after femoral vein ligation.

Of the 14 patients with ulceration, 6 have had complete healing of the ulcers for 1 year or longer. Others were healed for a shorter period of time. In 3 patients the areas are still unhealed. Reports indicate that there has been little improvement in the degree of swelling as compared with the preoperative status. Fatigue without exception continues to be a permanent symptom. When involvement was present above the level of the profunda femoris, vein ligation of the common femoral vein was carried out. It is believed that the level of vein ligation above or below the profunda femoris branch bears little relation to the degree or duration of postoperative edema, to the appearance of superficial varices postoperatively or to the end result.

The common iliac vein was ligated in 1 patient. Postoperative lumbar procaine injection produced little change in the patient's leg.

The inferior vena cava was ligated in 7 patients with a longstanding phlebitis of both lower extremities. The first patient upon whom a ligation of the vena cava was performed has now passed the twelve month period following it, and has no edema, although a prolonged trial without external supports has not been made. All the other patients in this group are still wearing supports. The outstanding end result in ligation of this type is the high incidence of healing of ulcers due to stasis. The most disappointing results have occurred in patients upon whom ligation was carried out when such ulceration was not present. The treatment has not been very satisfactory in this group.

RICHARD J. BERNETT, JR., M.D.

BLOOD; TRANSFUSION

Corelli, F.: *The Rh Factor the Cause of Fetal Erythroblastosis Hemolytic Disease of the Newborn and of Transfusion Reactions* (Il fattore Rh causa dell'eritroblastosi fetale, malattia emolitica del neonato e di reazioni da trasfusione). *Pediatrics* (n. ser.) 1945 51: 369.

This article is almost entirely a review of the American and English literature on the Rh factor which has already been ably reviewed. Its purpose is to acquaint such part of the Italian medical profession as is not already well acquainted with the subject—with the possibilities in the diagnosis and treatment of anemias, edemas, purpuras, and icteric conditions of pregnancy and infancy and with the explanation of many instances of abortion or premature delivery. Of course, many Italian doctors have been working in this field, for instance, Fontana has been transfusing with blood which is negative to the N factor.

The author himself finds an explanation of some of the mishaps in the past. For instance 1 of his recently observed patients who 3 years previously had received a number of transfusions without incident received another harmless transfusion incident to the development of a marked hypoplastic anemia. Thirteen days later she received another homogroup transfusion, which was succeeded an hour later by a typical severe reaction. Of course the mishap might be ascribed to the inadequacy of the crossmatching tests and even of the so-called biological test (an initial injection of 20 c.c. of the donor's blood with observation for 5 minutes thereafter). However, the author thinks that the patient had received blood in one of the previous transfusions which was positive for the Rh factor then in the first of the current two transfusions the blood was Rh negative and in the second it was Rh positive and this brought on the reaction. However the patient fortunately recovered.

Considerable space is given to the correspondence section of the *Journal of the American Medical Association* (1945 127: 1146) in which Darrow claims

that Rh positive blood should not be harmful to the erythroblastic infant. She postulates the correct methods of treatment for the condition, reserving perhaps for further study the question of transfusion with Rh positive blood and her opinions are accepted without reserve. The author also with apparent benefit has alkalinized the urine with bicarbonate of soda (4 gm. every 4 hours) and administered sodium lactate (Fox *J. Am. Med. Ass.* 1944 124: 127) for burn patients.

The author is now trying to build up a roster of Rh negative donors at the Uniti Hospital in Rome and intends to study further not only the question of the Rh factor but also the possibility of explaining the surprise reactions among the homogroups themselves in which the Rh factor does not always seem to be culpable. These reactions occur even in the O group and are possibly due to other as yet little noticed factors such as the factors M, N and P. He believes that other matters also should be included in these investigations such as the influence of the Rh factor in the unexplained occurrence of mental debility in children, as a high percentage of Rh positive infants delivered from Rh negative mothers has been found to be mentally deficient.

All of the aspects of this problem have been included under a broader conception which the author has designated as "Hemopathic Allergy." His book on this subject was published in 1944 by the publishing house of Pozzi in Rome.

JOHN W. BRENNAN, M.D.

LYMPH GLANDS AND LYMPHATIC VESSELS

Moreton, R. D.: *Lymphosarcoma with Primary Manifestations in the Gastrointestinal Tract. Report of 7 Cases Studied Roentgenologically*. *Texas State J. Med.* 1946 41: 458.

Lymphosarcoma is defined by Ewing as a true malignant neoplasm arising in lymphatic tissue from proliferation of atypical lymphoid cells. This occurs as (1) a localized or (2) a diffuse process. It is one of the larger groups of tumors referred to as malignant lymphoma or lymphoblastoma and should be classified under this general heading.

Because of the relative rarity of this condition the author thought it was advantageous to present a brief review of the pathological and roentgenographic findings as well as to present 7 cases of lymphosarcoma which manifested themselves as gastrointestinal lesions and were studied roentgenographically.

Two types of this tumor are recognized: the small cell lymphosarcoma or malignant lymphocytoma, and the large cell or reticulum cell lymphosarcoma. Some authorities believe the distinction between the two types is important from both therapeutic and prognostic standpoints. In the gastrointestinal tract the growth originates in the submucosa and invades in each direction involving on one hand the

mucosa, and on the other the muscularis of the bowel.

In summarizing the author notes that the term "tumefactive lesion" should be a useful one in the roentgenological field just as in gross pathological diagnosis. This term is used as a general one and does not define a specific etiologic or histological process, and is therefore used before the more refined methods of diagnosis are employed.

Radiologists are among the first to believe that roentgenological examination can be made to establish the presence of any tumefactive lesion in the gastrointestinal tract at least as early in the anatomic development of the lesion as the latter is able to cause symptoms and be manifested by clinical signs. A neoplastic lesion may be distinguished from a non-neoplastic lesion with about the same accuracy after the examination of the gross specimen. Surgical exploration has substantiated these beliefs to the extent that such roentgenological capabilities are well recognized.

Due to the rarity of lymphosarcoma as compared to carcinoma as well as the similarity of lymphosarcoma in the gastrointestinal tract to that of carcinoma in the same location, there is the tendency to report all of these lesions as carcinomas rather than tumefactive lesions or malignant neoplasms at the particular site noted.

In this condition the roentgenological findings are not sufficiently characteristic to allow a specific

diagnosis of lymphosarcoma of the gastrointestinal tract and for the reasons which have been stated carcinoma is the diagnosis that is most frequently made.

In conclusion, the author states that 7 new cases of lymphosarcoma with primary manifestation in the gastrointestinal tract have been presented. The series included 5 women and 2 men. The youngest patient was 51 years of age the oldest, 74. No distinguishing features of lymphosarcoma were found either in the history or on roentgenological examination. The 7 lesions viewed roentgenologically had an appearance indistinguishable from that of carcinoma.

All patients were subjected to an exploratory operation, the diagnosis being made from biopsies. Five of them were subjected to postoperative roentgen therapy as noted in the case reports. Five of the 7 patients have died, one, 10 days postoperatively of bronchopneumonia and the others, 7½ months, 20 months, 16 months, and 2 months, respectively, after first being seen at the clinic, apparently from the lymphosarcoma.

Two patients with involvement of the stomach were last seen at the clinic 34 and 36 months after their first admission. They showed no evidence of recurrence. One of these patients had been treated by resection and postoperative irradiation the other received irradiation alone.

HAROLD F. TAYLOR, M.D.

SURGICAL TECHNIQUE

OPERATIVE SURGERY AND TECHNIQUE POSTOPERATIVE TREATMENT

Smith, B. Cornell C. and Neill C. L.: Principles
in Early Reconstructive Surgery of Severe
Thermal Burns of the Hands *Brit. J. Surg.*,
1945 33 155

Regulations directing the proper use of protective
fire resisting apparel will reduce burn hazards in
military operations. Characteristic wartime burns
of the hand involve the tissue over the dorsum of the
hand and fingers and have a tendency to encircle the
wrist.

Deformity and disability resulting from thermal
burns of the hands may be reduced by early manage-
ment. The initial treatment is directed toward the
prevention of infection and the restoration of func-
tion. However infection and exposed tendons and
bones do not contraindicate early grafting. Radical
excision of slough granulation tissue and poorly
developed epithelium prepares the recipient surface
for a split thickness graft which is sutured in place
under the tension of normal skin.

Postoperatively dressings and splints are removed
on the fifth day. Rehabilitation exercises are ob-
served until maximum functional activity is ob-
tained.

Levenson S. M. and Lund, C. C.: Dermatomic Skin
Grafts for Burns in Patients Prepared with Dry
Dressings and with and without Penicillin
N. England J. M. 1945 33 607

Up to the time of the work presented in this re-
port, the results of skin grafting at the Boston City
Hospital were similar to those reported by Hirsch
et al. namely that in about one-third of the cases
there was less than 75 per cent take and in many of
the cases the failure was 100 per cent. It was there-
fore decided to try the use of penicillin given pre-
operatively.

Twenty-eight dermatomic grafts were done on 19
patients with granulating third-degree burns. One-
half of the patients received parenteral penicillin
treatment before and after grafting and the other
half received no penicillin.

In other respects the techniques used in the two
groups were identical. Before and after grafting dry
sterile pressure dressings were applied with adequate
splinting. The condition of the patients, the extent
and site of the burns, and the extent of the graft
were similar in the two groups.

All granulating areas were locally infected, but
there were no cases of spreading infection.
The hemolytic staphylococcus aureus, the proteus
vulgaris, and the pseudomonas aeruginosa were the
predominant organisms.
Penicillin had no effect on the bacterial flora or
the appearance of the wounds.

The results obtained in both of the groups were
excellent.
Simple dry sterile pressure dressings, infrequently
changed are recommended before and after skin
grafting.

It appears that the improvement in the results of
skin grafting that was coincident with the start of
this hospital was not due to penicillin since the results
of this study were not due to penicillin were
essentially the same as those in the patients who did
not receive penicillin. It should be emphasized however that
the results in the control cases were such that the
takes in the penicillin treated series would have had
to be essentially perfect in all cases to show a sig-
nificant improvement. There was no change in the
cultures from or in the appearance of penicillin treat-
ing wounds during the period of penicillin treat-
ment. It should be stressed however that there
were no cases of septicemia or cellulitis, the infection
being confined to local areas.

DANIEL H. LEVINTHAL, M.D.

Schmidt, E. R. and Hibma, O. V. Mortality after
Operation *West. J. Surg.* 1945 53 427

The authors have reviewed all deaths (138) follow-
ing operations done at the Wisconsin General Hos-
pital Madison in the year 1942. Classification of
these cases on the basis of evaluation as to the risk
of the given procedure shows that other factors such
as the type and amount of surgery play a greater
role.

Although the majority of deaths occurred in
the fourth, fifth and sixth decades it was believed
that more operations are done in these age groups
and that the mortality is actually highest in the very
young and the very old.

A review of the deaths occurring from 1938 to
1942, classified according to the recommendations of
the American Society of Anesthetists, shows a very
direct correlation the mortality varying from 0.085
per cent for those in the best physical state to 57.5
per cent for those practically moribund before
operation.

Seven deaths in the operating room are reported
with brief abstracts. The author points out that if
one is more interested in relieving the sufferings of
the patients than in the mortality rate the deaths are
unavoidable. More than half of the 138 patients
died after the third postoperative day.

Three conditions accounted for 45 per cent of the
deaths: pneumonia (19.5%) and cardiac failure (14.8%)
and failure (14.8%).

The authors emphasize that evaluation as to risk
is important that risk varies with the experience and
the clinical judgment and acumen of the surgeon and
anesthetist that routine orders are dangerous and

that close attention to particular systems without neglect of the patient's general condition is essential.
THOMAS C. DOUGLASS, M.D.

ANTISEPTIC SURGERY; TREATMENT OF WOUNDS AND INFECTIONS

Weinstein L. and Wesselhoof, C.: Penicillin in the Treatment of Tetanus. *England J M* 1945 33 682

Two cases of severe tetanus are reported in which recovery followed treatment with large amounts of antitoxin, surgical excision of the wounds and administration of large doses of penicillin.

Bacteriologic studies revealed that clostridium tetani could no longer be isolated from the wounds in these patients 24 hours after the first administration of penicillin. The already demonstrated antibiotic influence of penicillin on this organism in vitro therefore, appears to be confirmed in vivo.

The use of penicillin in tetanus appears to be most valuable in cases in which multiple lesions not all of which can be removed by surgical means, are present or in which no focus of infection is detectable. This antibiotic agent is not intended to replace the administration of antitoxin, excision of wounds, adequate sedation, and maintenance of a normal state of nutrition and hydration, but appears to be a highly important adjuvant to these other therapeutic measures.

McAdam, I W J: Penicillin Treatment of Acute Hematogenous Osteomyelitis. *Brit. J Surg* 1945 33 167

The lifesaving properties of penicillin are discussed, and its limitations in local infection and bone necrosis are emphasized in conjunction with 40 patients in whom penicillin treatment was used. The long bones were affected in 32 of the patients. The usual daily dose of penicillin was 100,000 units. Larger doses were used when indicated. Quite a wide variation in the serum level of penicillin was found.

Intramedullary injections of the penicillin produced a higher concentration in the pus. The intramedullary method is recommended when the infected metaphysis is intracapsular and there is an almost inevitable septic arthritis. It would appear from the results reported here that a route for the passage of penicillin from the metaphysical focus to the infected joint cavity is open. The introduction of a needle into the medulla of an infected bone serves several purposes: it allows the aspiration of a subperiosteal abscess; it relieves intramedullary tension; and it allows a bacteriological diagnosis to be made from the pus. In addition, it is used to administer the penicillin.

The length of time that organisms are found in the medullary cavity is very important in order to decide the duration of treatment. Among 18 patients, the average time for staphylococcal infections to be cleared up was 14 days, and the treatment was continued until three successive daily specimens of

pus proved to be sterile. The temperature chart and leucocyte count were not found to be reliable as guides to the severity of the local infection. Of 40 patients 31 had a generalized infection, 10 had metastatic foci, and 20 had positive blood cultures.

A large table is given in the original article, showing the details of treatment in 40 cases of acute hematogenous osteomyelitis. Among 32 patients with acute infections of the long bones treated with penicillin, 5 had operative treatment and the remaining 27 were treated conservatively. In 10 of the 40 patients septic arthritis occurred. This complication is most effectively treated by the aspiration of joint cavity every second day. Among 22 of the 32 patients who had infections of the long bones, 2 have poor function because of destruction of a joint; 1 patient developed a pathological fracture and 2 patients have discharging sinuses. In the remaining 17 patients, good function has resulted.

Penicillin treatment sterilizes bone in an average of 14 days. Before sterilization, however bone damage has occurred, even though it is not evident roentgenographically. Immobilization would appear to be advisable until there is roentgenographic evidence of recalcification.

In this series of 40 patients 19 had a staphylococcal septicemia, 9 had metastatic lesions, and 10 had a septic arthritis there was 1 death.

ROBERT J. BENNETT JR., M.D.

Kirby W B M., Leifer W., Martin, S. P., Rammeikamp, C. H., and Kinman J M: Penicillin in Oil. *J Am M Ass* 1945 129 940

Penicillin beeswax-peanut oil mixtures provide an effective and safe means of prolonging the action of penicillin in the body. Studies were made of the absorption and excretion of penicillin following intramuscular and subcutaneous injections of 300,000 units of penicillin in a 4.8 per cent beeswax in oil mixture. A single injection was administered to 51 patients with acute gonococcal urethritis and 35 received 8 daily injections, a total of 2,400,000 units in 8 days.

Calcium penicillin was used rather than the sodium salt because it was less hygroscopic, although there was thought to be no significant difference in the duration of the blood levels or in the clinical results because of the particular salt used. Penicillin was suspended in a 4.8 per cent beeswax in oil preparation. Intramuscular injections were made into the gluteal or deltoid muscles, and subcutaneous injections, into the subcutaneous tissues overlying the insertion of the deltoid muscle. The variability of absorption and excretion was striking, an important factor being the location of the injected material in relation to the muscle tissue and fascial planes, while the activity of the patient was apparently of minor consequence. It was concluded that there must be a continuous absorption from the muscle of a large amount of penicillin to insure ab-

sorption of about 2 500 units per hour. Slower more uniform absorption was obtained with subcutaneous injections because there are fewer and smaller blood vessels in the subcutaneous regions than in the deep muscle tissues therefore this route was considered superior although it was used in only 25 cases in this series.

Penicillin levels in the blood and in the urine were obtained in the 89 cases. The blood levels were determined by the Kirby Rantz modification of the Rammelkamp serial dilution technique (which detected as little as 0.04 units per cubic centimeter) and specimens were taken $\frac{1}{2}$, 1, 4, 8, 12, 16, 20, 24, and 28 hours after the injection. In 69 per cent of the 54 patients with gonococcal urethritis the blood levels were present for no longer than 12 hours and in about half of the 31 per cent in whom the levels were present for from 16 to 28 hours. Irregularity of absorption during the second 12 hours was noted. In only 7 per cent of the 33 luteic patients assayable levels of penicillin were present 24 hours after each injection. No cumulative effect of penicillin was noted. In both groups of patients urine was collected in 12 hour periods for from 48 to 72 hours and follow-up clinical observations were performed for a minimum of 31 days. The excretion of penicillin was found to decline rapidly after the first 12 hours but small amounts could be detected for 72 hours or more. The urinary excretion confirmed the evidence of superiority of the subcutaneous over the intramuscular route of injection.

In the one third of the patients who received subcutaneous injections it was observed that the absorption was more uniform and the levels were more prolonged in approximately two-thirds of these patients penicillin was present in the blood in detectable quantities for 24 hours or more.

From the preliminary clinical results it is concluded that, although larger amounts of penicillin are required than with penicillin in saline solution, penicillin-beeswax-peanut oil mixtures provide an effective and apparently safe method of prolonging the action of penicillin in the body. It is further concluded that an injection of the penicillin in oil mixture (300,000 units) should be made twice a day for treatment of infections in which it is desirable to maintain a therapeutic concentration of penicillin throughout the duration of treatment.

Soreness at the site of injection which persisted for 9 or 10 days was the only significant manifestation of the penicillin in oil injections (3 of the luteic cases developed a generalized urticaria) and this was less severe in the subcutaneous administration.

PHILIP B. CHART, M.D.

ANESTHESIA

Pleasance, R. E. Intravenous Anesthesia in the Tropics. *Current Res Anesth.* 1945 24 831.

This article is based upon experiences at a Base Hospital, and covers a period of 2½ years with intravenous anesthesia mainly pentothal sodium.

During this period 3 994 of 7 952 anesthetics, approximately 50 per cent, were intravenous anesthetics of some form. There were no fatalities in this series and no definite postoperative pulmonary complications. The operative cases varied considerably and included most types of minor surgery and diagnostic procedures, as well as maxillofacial, plastic, orthopedic, and extensive surgery of the cranial vault, chest, and abdomen. Pentothal alone was used when possible but the more extensive procedures were performed under a combination of pentothal and some other form of anesthesia, preferably gas and oxygen.

The author lists the following types of cases as suitable for intravenous anesthesia.

Patients who desire to avoid unpleasant inhalation agents.

Patients who resist other forms of anesthesia.

Patients who are unable to tolerate a mask over the face.

Patients who have had little or no premedication.

Patients who require a supplement to spinal anesthesia.

Patients who are subjected to minor operations manipulations or examinations under anesthesia.

Patients who are subjected to selected major operations.

Patients who require an antidote to the toxic effect of local anesthetics.

Patients who are having convulsions from drug poisoning either or tetanus.

Patients who require sigmoidoscopic or cystoscopic examinations or application of the diathermic cautery.

The tendency toward laryngeal spasm makes the use of pentothal for bronchoscopy hazardous unless an expert in the arts of both anesthesia and bronchoscopy administers the pentothal. Lundy's method of reinforcing the preliminary infection after a few minutes of waiting and proceeding to a deep plane is advocated.

The following patients are not suitable for intravenous anesthesia.

Children under 7 years of age.

Patients with severe liver and kidney disease.

Patients with suppuration in the neighborhood of the neck.

Patients with cystitis and latent pyelitis.

Possibly patients with asthma and those who have been treated with preparations of sulfanilamide, those with dyspnea from any cause, with severe anemia, cachexia and dehydration with cardiac decompensation, with hypotension, or with varicosities are also unsuitable for intravenous anesthesia.

In this extensive series, the author noted some complications such as venous thromboses, severe headache, unusual urticarial-like eruptions, vomiting, exacerbation of latent malaria, priapism, jaundice, and intra-arterial infections eventuating in the loss of the extremity.

Since barbiturates are broken down in the liver and excreted by the kidneys great care must be

exercised in the use of pentothal in a tropical climate, where liver disease or deficiency is comparatively common. The fall in blood pressure and depression in respiration depend upon the rapidity with which the anesthetic agent is injected. The four stages of anesthesia discussed are light narcosis, the "stage of inebriation anesthesia, and premortem."

Induction, as well as recovery is quiet, but occasionally the patient is irrational, noisy and hyperactive. Whenever possible, the solution (2.5%) should be freshly prepared at least 10 or 15 minutes before injection. Preoperatively the patient should be prepared as for a general anesthetic, and if the procedure requires a prolonged anesthesia, morphine (gr 3/4) and atropine (gr 1/100-1/150) should be given. The following techniques of administration are used (a) the single dose (b) the intermittent dose and (c) the continuous dose. These techniques were dependent on whether the case was (1) a simple surgical procedure, (2) a general surgical procedure requiring prolonged anesthesia, (3) a cerebral case, (4) a case of maxillofacial surgery or (5) a case of thoracic surgery. Postoperatively routine use is made of one of the detoxicant drugs—coramine, phreparol, or picrotoxin, and the patient is carefully watched until the return of reflexes or even consciousness. The author judiciously concludes, "The ease of its administration may constitute the greatest danger of pentothal."

DAVID H. LYNN M.D.

Edwards, G: Trichloromethyl Alcohol (Avertin, Bromethol) *Proc. R. Soc. M. Lond.* 1945 39 71

The author describes the first case narcotized by avertin in England as well as additional experiments with the drug up to the present time. It is now being administered routinely.

This drug has had widespread popularity from its initial introduction into England in 1927. In 1936 50 per cent of the hospital patients and 65 per cent of the patients in nursing homes were given avertin. However its popularity has waned since that time during the last 12 months less than 5 per cent of the

hospital cases and less than 10 per cent of the private patients have received this drug. A 1/10 gm. per kilogram dose has been used from the start. The original 3 per cent solution used has been changed to a 2½ per cent solution. The Congo red test was used to determine traces of hydrobromic acid. Rectal plugs and postoperative washouts were used at first but were soon discarded as worthless. It was soon learned that avertin should be given as a basal anesthetic only total anesthesia with the drug was found to be dangerous.

Avertinized patients retain an active cough reflex. Coramine gives an effective counteraction to an overdose. Although avertin is unlikely to damage a healthy liver it should be avoided if there is any suspicion of impaired hepatic function. It has little effect on renal function and nitrogen excretion. It is not recommended for chest surgery because prolonged basal narcosis is found to be a contributing factor in postoperative chest complications. There is no contraindication to its use for throat surgery. It is indicated in hyperthyroid patients and those patients who prefer to be asleep before going to surgery. It is contraindicated in inflammations or lesions of the rectum or large bowel, in operations in the region of the rectum, and in any condition which produces a definite deviation from the physical normal, such as fever anemia, obesity cardiac or respiratory affections and renal or hepatic lesions.

The author's present routine consists of administering an enema from 6 to 12 hours before surgery and giving atropine (gr 1/100) 10 minutes following the avertin injection. The avertin dose is 1/10 for a gram per kilogram with a maximum of 8 gm. Trichloromethyl alcohol was used in a group of 18 cases. This drug was found to be more hypnotic and to cause less respiratory depression than avertin. It caused excitement both during the onset of narcosis and during recovery and the eighteenth case presented cardiac failure early during the onset of narcosis. For this reason the use of trichloromethyl alcohol was discontinued.

MARY KARP M.D.

PHYSICOCHEMICAL METHODS IN SURGERY

ROENTGENOLOGY

Packard, C. Roentgen Radiations In Biological Research. *Radiology* 1945 45 532

This article summarizes the study of the effect of the roentgen rays on living cells since Roentgen's discovery in 1895 and the use to which these effects have been put in biological research. It was discovered early that x rays were of little use as a bactericidal agent, but that large doses resulted in the coagulation of plant and animal cell protoplasm. There was early recognition of the sterilizing effect of the x rays on animals and both radium and roentgen rays have been of use in analyzing the role played by the cytoplasmic portion of the sperm and egg since it has been found that the nuclei of gametes can be injured in varying degrees without preventing cleavage of the egg.

Three types of chromosome change following irradiation have proved important cytogenetically by causing an increase in the number of mutations and chromosomal aberrations over the rate found in nature, and apparently giving rise to the same alterations in the hereditary material as in the spontaneous cases. x rays furnish a valuable means of study of such phenomena. The first of these small changes consists of the increased stickiness of pairs of chromosomes which causes some of them to stick together instead of separating during the maturation process with resultant hereditary changes in the offspring. Radiation may increase the frequency of this phenomenon over that found in the offspring of nonirradiated parents by as much as 20 times. The second of these changes consists in the sticking together of certain portions of the chromosomes and their subsequent breaking apart under the pull of spindle fibers with subsequent reattachment of fragments either to the same chromosome in their original orientation or in reverse position or to the broken ends of other chromosomes. Precise determination of the chromosomes involved and the fate of their parts has been achieved in careful experiments. The third effect is a change in the gene itself which greatly increases the mutation rate (Muller in 1927 working with *Drosophila*) this increase is proportional to the amount of energy absorbed.

Sensitivity to radiation changes rapidly during mitosis, but whether prophase, metaphase or telophase is the most vulnerable period is still in dispute. It was demonstrated by Bergonie and Tribondeau in 1906 that the sensitivity of cells in general varies with their reproductive capacity and inversely with their degree of differentiation, and it has been established that during the development of an organism there is a progressive loss of sensitivity. Although decrease in sensitivity is synchronous with decrease in growth velocity experiments which

induce increase in the normal growth rate have not produced a comparable increase in radiation effect. It appears that when cell division and metabolism are at a minimum as during chilling cells have a better opportunity to recover from their injury but Henshaw and Francis working with wheat seeds found no quantitative relation between susceptibility and water absorption, oxygen consumption and mitosis although sensitivity rises when water is absorbed and growth commences.

There is general agreement that the primary effect of irradiation on the tissues is an ionization, resulting in transformation of complex molecules to simpler ones but the precise point of primary attack and the pattern of chain reactions which may be precipitated has yet to be worked out. x rays have been repeatedly shown to have no direct effect on oxygen consumption but work by Crabtree and Gray indicates that they have an effect on glycolysis and work by Dale that they inactivate dilute carboxypeptidase while Sparrow states that perhaps the sensitivity to x rays may be correlated with the nucleic acid metabolism.

In 1904 Koernicke demonstrated the ability of organisms to recover from x ray injury but it was not until 1932 that Henshaw offered quantitative data in proof of the generally accepted principle that when x ray intensity is low the rate of repair is sufficient to balance the rate of injury. He found that when arabidopsis eggs are irradiated and then fertilized, the onset of division is delayed the delay being an exponential function of the time interval between the end of exposure and the moment of fertilization and the period of recovery apparently being limited to the quiescent interval between irradiation and fertilization.

LILIAN DONALDSON, M.D.

Sinberg, S.E., and Burman, M. S.: Roentgenologic Visualization of the Fractured Temporal Styloid Process. *Radiology* 1945 45 599.

The roentgen visualization of the temporal styloid process is often difficult. The lower part of the bone may be seen in posteroanterior roentgenograms made for the demonstration of the maxillary sinuses, in the open mouth view of the edentulous patient, and in the lateral view of the nasopharynx and neck, but the entire bone is shown rarely.

The authors became interested in the roentgen visualization of the styloid process in connection with a rather unusual case which is described in the text and illustrated with their respective roentgenograms.

A technique developed from that of Kaplan was found to be of definite value. It is given as follows:

For visualization of the right styloid process, the patient is seated in the right oblique position (about 15 degrees) with head bent to the right at an angle of

about 10 degrees. The head is extended about 10 degrees to bring the mandible out of the line of the styloid. The cassette is placed upon the patient's right shoulder and held firmly against the side of the neck and head by his right hand. The x-ray tube is set from 30 to 35 cm. to the left of the patient's knees. The tube is then tilted upward about 45 degrees and backward about 30 degrees, so that the central ray enters the left side of the neck in an oblique and upward direction from 3 to 4 cm. below the angle of the mandible.

By making use of this technique the authors were able to demonstrate a fracture of the temporal styloid process in both cases. T. LECURU, M.D.

Renander, A.: Roentgenologically Examined Cases of Cancer of the Thymus Gland (Röntgenologisk undersökt Fall von Cancer thymus). *Acta radiol.*, Stockholm, 1945, 26: 197.

The consensus of roentgenologists is that roentgenograms of malignant tumors of the thymus gland are not characteristic enough to allow a definite diagnosis. However, Lenk called attention to certain features which permit a correct diagnosis in a large percentage of cases. The author of this article describes a case of cancer of the thymus gland in which the picture differed in certain respects from that considered as characteristic for malignant tumor of the thymus gland by Lenk.

According to the prevailing opinion the medullary substance of the thymus gland is of endothelial origin and therefore belongs to the epithelial structures while the cortical substance is formed mostly by cells deriving from lymphocytes. It follows that malignant medullary tumors of the thymus gland belong to the group of lymphosarcomas. This classification must be kept in mind when x-ray irradiation is employed for diagnostic purposes because a carcinoma while a sarcoma yields to the therapy promptly resembling the lymphosarcoma of the mediastinal glands in this respect. In this manner a carcinoma can be differentiated from a lymphosarcoma.

The clinical picture is dominated by pressure symptoms. Frequently signs of congestion in the region of the superior vena cava are noticed later on dyspnea, cachexia and metastases develop.

According to Lenk, malignant tumors of the thymus gland located in the anterior mediastinum form more or less symmetrical tumefactions which as a rule reach the base of the heart. In contradistinction to glandular tumors located in the anterior mediastinum the upper border of a thymus tumor does not reach the "jugulum." As a rule, a thymus tumor has a rounded shape with polycyclic margins, while glandular tumors form relatively short arches, while arch formations are characteristic for thymus tumors. Contrary to glandular tumors the transverse diameter of thymus tumors exceeds that of the longitudinal diameter this being due to the growth of

thymus tumors within a preformed capsule. In roentgenograms the thymus tumor forms a sharp outline unless the tumor mass penetrates the capsule and infiltrates the adjacent pulmonary tissues. A thymus tumor usually causes a displacement of the adjoining organs. Dermoid cysts, accessory spleen, and aneurysms are characterized by an asymmetric shape.

In a case of malignant thymus tumor in a 75 year old man observed by the author, the type of the mediastinal tumor could not be determined roentgenologically. A percutis of the phrenic nerve and an enlarged cervical gland suggested malignancy. The diagnosis was supported by the asymmetrical shape and an extension of the mediastinal tumor into the right cervical region. A complete regression of the enlarged cervical gland under the influence of x-ray treatment supported the diagnosis of malignancy of a lymph gland. On the other hand the outlines of the tumor in the roentgenograms were sharp long polycyclic arches were noticed, and the transverse diameter of the shadow was slightly longer than the longitudinal diameter. The microscopic examination of the tumor revealed a cancer of the thymus gland. JOSEPH K. NARAY, M.D.

Duane, L., Hermon, R., and Dagnall, D. J. T.: Pneumococci in Radiator and Boiler Flashes. *Brit. J. Radiol.* 1945 18: 377.

Chest roentgenographs of 13 boiler fitters and radiator fitters showed signs of pneumococci in 10. Only 2 had disabling complaints and the chest films of 1 of these 3 men were essentially negative. The authors attribute the roentgenographic findings to inhalation of dust consisting of sand (from the casting molds) iron, and oil. The exposures ranged from 9 to 36 years.

An analysis of 3 dust specimens, which were obtained by different collecting methods, showed that the content of iron ranged up to 6.5 per cent. The main constituent was silica. Its solubility depended on the size of the particles. The amount of soluble silica did not exceed 0.45 per cent. The average size of the particles was 5 microns in the unfiltered specimen. GERHART S. SCHWARTZ, M.D.

Wilson, A. K.: Roentgen Examination in Congenital Intestinal Obstructive Defects in Infants. *Am. J. Roentol.* 1945 54: 498.

The author presents 3 cases of congenital obstructive anomalies of the intestinal tract in newborn infants, and describes the roentgen techniques used in ascertaining the point of obstruction. For cases of imperforate anus and rectal atresia he uses the method described by Wangenstein and Rice in 1930 whereby gas in the large intestine is used to delineate the blind end of the rectal pouch by suspending the infant head down and placing a radiopaque object in the anal dimple. This demonstrates the extent of separation between the blind end of the rectum and the perineum to aid the surgeon in determining whether a perineal approach is feasible. In



Fig. 1 Case 1. Anteroposterior and lateral views made (a) immediately (b) 5 minutes after and (c) 10 minutes after the infant was suspended head down. Note gradually increasing ascent of gas in rectal pouch, and that there is greater clarity of detail and less risk of erroneous measurement in the lateral projection. The tip of the thermometer is in contact with the anal dimple.



Fig. 3 Case 3. The findings in (a) reproduced from a roentgenogram made 10 minutes after the infant was suspended head down, show evidence suggestive of high rectal imperforation. This was disproved by insufflation of air (b)

and the injection of iodized oil (c). The partially calcified enterocyst is seen in (c) and (d) in close proximity to the mobile proximal end of the colon.

cases showing an anal pouch, injection of opaque medium is recommended for an accurate estimate of the depth of tissue between the anal membrane or perineal surface and the blind end of the rectal pouch.

In one of the cases presented 5 per cent lactose was given by mouth some hours before examination in order to increase gas formation in the bowel in the newborn. Roentgenograms were then made at least 5 and preferably 10 minutes after the infant was inverted in both the anteroposterior and the lateral projections. It was found that if films were made immediately after inversion the gas might not have reached the distalmost portion of the rectal pouch whereas the gas localization after 10 minutes corresponded well with subsequent surgical findings. The lateral projection was found of greater value in estimating the thickness of the tissue between the rectal pouch and the perineal skin surface since the pelvic curve of the intestine foreshortens the distance between these points in the anteroposterior view. The latter projection may be of value however in demonstrating possible deviation to the left or right of the terminal end of the rectum.

The first case was that of a premature male infant, with no anal orifice but with an anal dimple. It was given 35 ounces of 5 per cent lactose by mouth approximately 12, 15 and 18 hours after birth, and at 27 hours was suspended head down with a thermometer tip in apposition to the anal dimple. Anteroposterior and lateral films were taken immediately and 5 minutes and 10 minutes after suspension, and the lateral views showed the distance between the gas-distended, closed end of the rectum and the tip of the thermometer to be respectively 5 cm, 1.5 cm., and 1 cm. (Fig. 1). Confirmation of the accuracy of the 10 minute film was obtained an hour later when incision was made through the anal dimple and the blind pouch was encountered 1 cm. above the cutaneous margin.

The second case was similar to the first.

The third case was that of a premature female infant who developed persistent projectile vomiting about 2 hours after birth. The first films (Fig. 2) made 18 hours after birth by the method described, tended to support the clinical impression of high rectal atresia as there was considerable distance between the tip of the rectal catheter and the collection of rectal gas. The insufflation of air and injection of 15 c.c. of iodized oil, however, demonstrated free passage up the colon as far as the transverse portion which was displaced to the left by a large movable partially calcified cystic mass. In spite of ileostomy the infant died 60 hours after birth. Autopsy showed a large enterocyst joined to the terminal ileum by a fibrous strand and to the mid ileum by an almost atretic loop while the terminal ileum ended blindly a few centimeters from the colon.

Cases 2 and 3 were the only cases of imperforate anus or intestinal atresia found among 9,474 living babies born in the Hospital of St. Vincent de Paul Norfolk, Va. between 1923 and 1944.

LESLIE DONALDSON M.D.

Isaac, F. I. Roentgen Findings in Amebic Disease of the Liver. *Radiology* 1945 45 581.

The author calls attention to amebic disease of the liver manifested first as a diffuse hepatitis and progressing in some instances to the formation of solitary or multiple liver abscesses, as the most common complication of amebic dysentery and reports that of the 222 cases of such dysentery reviewed at an Army hospital overseas, 32 (14%) were diagnosed as presenting liver involvement.

The onset of this complication is usually insidious with only anorexia, malaise, and vague epigastric distress with the result that the patient may not appear for diagnosis until several months after an initial attack of diarrhea, and then usually with only low grade fever, moderate leucocytosis, an elevated sedimentation rate and tenderness over the liver without any frank pathognomonic signs on physical examination. For this reason the author believes the associated roentgen changes, if present, may be of considerable help in suggesting or clinching the diagnosis.

Of the 32 cases diagnosed as amebic hepatitis 22 were examined roentgenologically, of these, 10 (45%) showed elevation of the right leaf of the diaphragm in the chest films, and fluoroscopic movement of the diaphragm was reduced or absent. In regions where amebic dysentery is prevalent, the author regards these roentgen findings pathognomonic of amebic liver disease. Secondary compression of markings in the base of the right lung frequently accompanied the diaphragmatic elevation and occasionally there was a little pulmonary infiltration. In a few instances minimal right costophrenic pleuritis and effusion were also encountered which the author believes was due to rupture of a liver abscess into the pleural cavity. Prone abdominal films were not always helpful, but in some cases they did show a downward extension of the inferior hepatic border as related to the costal margin.

Following a course of emetine therapy these roentgen signs disappeared but more slowly than the symptoms. In only a very small percentage of cases did amebic liver disease require aspiration.

LESLIE DONALDSON M.D.

Brooke, H. H. W., MacKenzie, W. C., and Smith, J. R.: Pneumoroentgenography with Oxygen in the Diagnosis of Internal Derangements of the Knee Joint. *Am. J. Roentg.* 1945, 54 462.

The authors used oxygen pneumoroentgenography for the diagnosis of internal derangements of the knee joint whenever the clinical evaluation remained inconclusive and the routine roentgen examination failed to help although the symptoms strongly suggested some sort of disability.

A total of 25 cases were examined of which 18 showed positive findings. Ten cases came to operation and in all but 1 the roentgen findings were confirmed. The failure in the tenth case was attributed to insufficient removal of the synovial fluid and in complete filling of the joint cavity with oxygen.

The authors give in detail the anatomic and surgical considerations. The procedure must be done in the operating room under aseptic conditions. From 100 to 140 c.c. is the optimum amount of oxygen necessary for good filling. Collodion is applied to the needle puncture site and then the patient is taken to the roentgen department on a stretcher. Roentgenograms are made in standard positions. The use of the curved cassette holder and multiple stereo projections are however of definite value.

In the interpretation of the abnormal pneumo-roentgenogram of the knee joint the following points were found to have diagnostic significance: (1) roughening and narrowing of the cartilage surfaces either of the articular surface coverings or of the semilunar cartilages; (2) uninterrupted gas columns along the inner aspect of the collateral ligaments of the joint where capsular structure should be firmly attached to the periphery of the menisci; (3) increased density in the intercondylar or nonarticular region with a corresponding lack of density in the lateral or medial region of the joint; (4) separation of the meniscus shadow from the contiguous bone structures; (5) calcified and more especially non calcified loose or semiloose bodies (joint mice); (6) narrowing of the joint space and (7) exostosis or churning of the articular surfaces. The last three findings can also be demonstrated in the routine roentgenograms of the knee.

The conclusion is reached that the method is a useful adjunct in well selected cases. Under aseptic surgical conditions it carries little risk of complications.

T. LEUCOTTA, M.D.

Coolidge, W. D. and Charlton E. E.: Roentgen Ray Tubes. *Radiology* 1945 45 449

The authors describe the technological development of x ray tubes from the simple gas discharge tube first used by Roentgen in which the glass wall of the tube functioned haphazardly as the x ray emitting target under bombardment by electrons to the one hundred million volt circular induction electron accelerator tube, which promises to become not only a widely used instrument in medicine and industry but also a source of unpredictable scientific information.

There are essentially 3 groups of x ray tubes: 1. Gas filled tubes, most of which operate with a cold cathode. They are antiquated mainly because of their instability and the impossibility of controlling the current passing through them and of choosing the voltage applicable to them independently from current and gas pressure.

2. High vacuum tubes with a cold cathode (so-called field current tubes) which did not gain acceptance for similar reasons.

3. High vacuum tubes with a hot cathode. This type of tube is the only kind used extensively today. It was developed by one of the two authors (Coolidge) whose name it bears. Encouraged by the work of Langmuir he developed a hot cathode which con-

sisted of an electrically heated tungsten filament whereas Lilienfeld tried to solve this problem by introducing an auxiliary hot cathode which produced electrons in a separate ignition chamber.

Coolidge tubes have now been developed to cover a wide range of usefulness. They vary in size from that of an oil immersed dental tube with a bulb diameter of $1\frac{1}{4}$ inches and a length of 4 inches up to that of the 1,400,000 volt tube of the National Bureau of Standards which is 12 inches wide and 24 feet long. The effective wave length of the radiation generated in such tubes ranges from 0.00025 Angstrom at 100,000,000 volts to 25.0 Angstrom at 1000 volts. (A table showing the relationship of the factors is given.) The efficiency of these tubes increases with the voltage. Whereas at 96,000 volts only 0.2 per cent of the cathode ray energy is transformed into x rays in the target, the measured efficiency reaches 10.4 per cent at 2,350,000 volts. (A table showing the wave lengths and the efficiency relation is given also.) The advantages of Coolidge tubes over others are described.

Further technical developments are as follows:

For roentgenographic tubes

Development of a rapidly cooling tungsten target brazed into a solid or hollow copper block which in turn is cooled by: (1) possessing a large heat capacity; (2) with stagnant or circulating air by means of radiator fins; (3) with water and (4) by a spontaneous or forced circulation of oil passing through the back of the target which in turn is cooled by air or other media.

Development of the line focus: a rectangular focus which by having a slant of 20 per cent (the angle being made by the target surface and the central x ray beam) appears foreshortened in the useful projection, thus equaling a square focus. This line focus is able to withstand the 3 fold load of an ordinary focus of the same projected size. (Values for other angles and curves for load limits are given.)

Development of target sizes varying from 1 to 9 mm. in diameter for different purposes. The allowable loading varies from about 50 to 600 watts per square millimeter.

Development of double focus tubes. Tubes having two foci of different size allow rapid changeover from fluoroscopy to roentgenography which is necessary for the so-called spot film medical roentgenography and other two purpose raying.

Development of a rotating target which allows the constant advance of relatively cold metal to the electron bombardment during a given exposure. In modern rotating target tubes the anode disc rotates with from 3000 to 3500 revolutions per minute. The gain in loading over the stationary target, is then about 10 fold and is generally proportional to the target speed. (A table for the various speeds and exposure times is given.) The line focus principle is maintained in these tubes. Technical difficulties with the target bearings still exist but have been overcome in part by coating the bearing balls with silver or barium.

For therapy tubes

Development of improved cooling of a solid tungsten target which is allowed to heat up to high temperatures. Since an x ray treatment may last for up to an hour the tubes have to be designed for continuous operation. (The focal spot is allowed to be larger than for diagnostic tubes.)

Insertion of a beryllium metal window into the glass wall of the x-ray tube for superficial therapy to allow the passage of very soft x rays from 5 to 10,000 volts for superficial therapy.

The use of thick walled pyrex glass for from 200 to 400 kv deep therapy tubes to prevent the occurrence of punctures.

The use of a metal hooded target to improve the electric field distribution. This will not allow the secondary electrons emanating from the target to reach the glass wall and thus cause punctures. The metal hood may be made to include a beryllium window.

Use of the x ray beam "transmitted" through the target instead of the conventionally used "reflected" beam. This principle is of value for the operation of contact and body cavity tubes. It is a necessary one in the use of supervoltage machines if the voltage is to exceed several million volts because of the peculiar angular distribution of highly penetrating x rays. (Data for the angular distribution at various voltages are given.)

Development of multisectional tubes for 1,000,000 volt machines which allow a more even distribution of the voltage gradient within these tubes by the use of a number of ring shaped electrodes connected to different intermediate voltages. This principle is of special value in the 1,000,000 volt mobile resonance transformer unit in which the tube is surrounded by the transformer coils and the electrodes connected to a number of coil taps.

For diffraction tubes

Use of several windows permitting the simultaneous diffraction or spectrographic study of several specimens. Diffraction tubes operate usually on between 30 and 45 kv and utilize the characteristic radiation of various target metals, e.g. copper and molybdenum.

For all types of tubes:

Development of x ray proof and shock proof tube housings. This more than anything else enables us to enjoy the use of flexible comparatively safe x-ray equipment without which modern radiology is unthinkable.

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Development of x ray proof and shock proof tube housings. This more than anything else enables us to enjoy the use of flexible comparatively safe x-ray equipment without which modern radiology is unthinkable.

Most of the described technical advances were made possible only by the Coolidge tube principle.

GERHART S. SCHWARTZ, M.D.

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CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Loutit, J. F., and Mannsall K. The Prevention of Homologous Serum Jaundice *Brit M J* 1945 2:759

Homologous serum jaundice occurs from 40 to 160 days after the introduction of a foreign homologous serum into a recipient. Its occurrence may be accidental, as in so-called syringe jaundice which is believed to result from the injection of traces of foreign blood left in an inadequately cleaned syringe; it may occur following the deliberate injection of serum or plasma as a transfusion or of convalescent serum given as a prophylactic in measles and mumps or following yellow fever vaccination in which human serum is the suspension medium for the killed virus. As to the accidental variety adequate cleaning and sterilization of syringes and needles has been shown to reduce the incidence of jaundice practically to zero. When the introduction of serum is deliberate the prevention of homologous serum jaundice is much more difficult. The yellow fever vaccine problem was solved only by giving up the use of serum as a suspension medium.

This report deals with the results of the introduction of single sera into a number of recipients and a comparison of the incidence of jaundice in these cases with that in a series of cases subjected only to blood transfusions. Blood was drawn from 99 separate donors under sterile conditions, of these 76 had had no previous known attacks of jaundice, 15 had had jaundice apparently from infective hepatitis, for some months to many years previously, 4 had had homologous serum jaundice some months previously, and 4 were donors who had contributed the only blood which had been used for transfusion to a man with hematemeis who 6 weeks later developed jaundice. Of 98 donors followed up for 4 months 94 had no complaints, 3 had bilious attacks, 1 donor had a skin rash, and none had jaundice. Of 602 recipients of sera from the 99 donors 573 could be followed, none of them reported jaundice, but 11 reported bilious attacks and 3 reported skin rashes. It is probable that the bilious attacks and skin rashes were nonspecific in both series.

For comparison 213 patients who had received whole blood or concentrated red cell suspension were studied over a period of 2 months or more. No case of frank homologous serum jaundice occurred in this series although there was 1 case of jaundice diagnosed as infective hepatitis and 1 case diagnosed as hepatitis without jaundice. The findings confirm the impression that homologous serum jaundice occurs only rarely after transfusion with whole blood. This is probably due to the fact that patients receiving transfusions of whole blood alone get homologous material from a few donors only.

In addition to this follow-up only 2 cases suggesting a relationship between whole blood transfusion and subsequent hepatitis have been found. In these cases blood was received from more than 1 donor (4 and 52 donors respectively). It is recommended that for therapeutic and prophylactic purposes the serum used should be from a single individual, or from a few persons only.

JOHN L. LINDQUIST, M.D.

Harrison F. F., and Miller J. K.: The Problem of Hemolytic Streptococcus Carriers in Hospital Personnel. *War Med Chic.*, 1945 8:333

A situation is described in which the occurrence of 2 postoperative infections in aseptic cases seemed to be related to a high hemolytic streptococcus carrier rate among the surgical personnel. The carrier rate was not effectually reduced by chemotherapy. A comparison was made of the incidence of streptococci in the throats of the surgical personnel and of the patients and in the wounds of patients during the winter months of 1944 and 1945.

The authors suggest that as a precautionary measure periodic surveys of the flora of the throats of surgical personnel be made.

WALTER H. NADLER, M.D.

Snell A. M., Wood D. A., and Meisberg, L. J.: Infectious Hepatitis, with Especial Reference to Its Occurrence in Wounded Men. *Gastroenterology* 1945 5:247

Infectious hepatitis has currently manifested itself as three more or less distinct clinical entities: the common epidemic jaundice, postvaccinal (yellow fever) hepatitis and homologous serum jaundice. There is no reason to presuppose any fundamental difference in these conditions, the clinical variations probably being due to the route of inoculation and to the general condition of the affected individual. While the supposed relation of the three syndromes is not proved it is generally agreed that all fatal cases of any of the three types have shown a common picture at autopsy namely that of acute or sub-acute (yellow) atrophy of the liver.

This report deals with the cases of 32 patients who developed jaundice on an average of 84 days following a wound. All of the patients had received blood and plasma at the time of injury and it is believed that the ensuing hepatitis may have resulted from an iatrogenic agent contained therein. Twenty six of the patients recovered, the remaining 6 expiring on an average of 1 week after the jaundice was first noted. The initial symptoms at the time of the appearance of hepatitis were almost identical with those described in ordinary epidemic or catarrhal jaundice. Anorexia, nausea, vomiting, general malaise, and fever were first noted and after an interval of from 1 to 16 days jaundice appeared. Eight

patients, including the 6 who died, developed marked symptoms and signs of involvement of the central nervous system. Surprisingly, the liver and spleen were rarely palpably enlarged in the early stages of the disease. Cephalin-cholesterol flocculation tests were positive in all of the patients at some time during their illness. Although the studies of the hepatic function were limited to those required by medical necessity all of the studies revealed less deviation from the normal than might have been expected. Essential pathological findings in the liver in the 6 fatal cases consisted of an acute autolytic process which was diffuse and most marked in the central and midzonal areas of the liver lobule. Little evidence of regeneration or repair was observed in these cases presumably because of their brief and violent course.

There was no evidence that the disease had been transmitted by droplet infection to other patients in the ward. A laboratory worker who inadvertently drew up a mouthful of serum from a fatal case developed a mild form of the disease 19 days later. There is ample evidence that the preicteric phase of hepatitis may be detected clinically in these cases, as in the experimentally produced variety of the disease. In 1 case it was predicted that jaundice would develop on the basis of two positive cephalin-cholesterol flocculation tests on 2 different days. From this and similar observations it is believed that the cephalin-cholesterol flocculation test becomes positive long before clinical symptoms develop and is probably the earliest evidence of an impending acute hepatitis to be obtained in wounded men.

The authors could not be certain that these cases of severe hepatitis were due to what has been called homologous serum or transfusion jaundice. The incubation period corresponded closely to that seen in hepatitis following yellow fever vaccination and in experimentally produced serum jaundice. The average course prior to the development of serious symptoms in post vaccinal hepatitis is about 36 days as contrasted to 3 or 4 days in this series. Two possibilities suggest themselves as in why the disease should follow so serious a course in the wounded men in this series: (1) that the amount of heterogenic material was very much larger than that transmitted in vaccinal hepatitis or in experimental serum jaundice and (2) that the general nutritional depletion of the wounded men makes them especially vulnerable. The latter view seems the more reasonable.

The essential requirement for the prevention of serum jaundice in wounded men is elimination of the use of blood or plasma containing the heterogenic agent. The practical difficulties of doing this are great. The prevention of fatalities from serum jaundice occurring in wounded men must begin with the maintenance of the general nutrition of the patients and the correction of protein and vitamin deficiencies if such exist. Early detection of the preicteric phase is also a matter of considerable im-

portance as specific treatment may save lives and shorten convalescence. JOHN L. LINCOLN, M.D.

Dorjello, J. R., and Tully, P. W.: The Relationship of Boeck's Sarcoid and Tuberculosis: Report of a Case in Which Tuberculosis of the Lymph Nodes was Associated with Features Highly Suggestive of Sarcoid. *Arch. Path. Chlc.*, 1945 40 300.

Tuberculosis of a cervical lymph node was found in a patient exhibiting no cutaneous reaction to tuberculin. Portions of the lesion presented caseation with acid-fast bacilli in other areas, however the histological picture was indistinguishable from that of Boeck's sarcoid. It is believed that this case lends additional weight to the argument that sarcoidosis, in some instances at least, is an atypical reaction to tubercle bacilli or their products.

That this relationship may occur even though bacilli usually are not demonstrable in the lesions of sarcoidosis is substantiated by the occurrence of the organism free "id" reactions of leprosy and mycotic infections and the generally conceded relationship of streptococci to rheumatic fever and glomerulonephritis. SAMUEL KAHN, M.D.

Kilns, B. E., Miller, J. A., Roach, H. P., and Baumann, G. A.: Certain Effects of Dietary Fat on the Production of Liver Tumors in Rats Fed p-Dimethylaminobenzene. *Cancer Res.* 1946, 6 5

Six groups of 15 rats each were fed 0.06 per cent of p-dimethylaminobenzene for 4 months in synthetic diets containing: (1) no fat, (2) 5 per cent of corn oil, (3) 5 per cent of olive oil, (4) 30 per cent of corn oil, (5) 30 per cent of Crisco, and (6) 30 per cent of lard. Then a dye free diet was given for 3 months. A final incidence of liver tumors of 33 per cent was produced by the low fat diet, as compared with 94 and 33 per cent, respectively when the diet contained 5 per cent of corn oil or olive oil. When 30 per cent of corn oil was fed to the rats, large tumors were present before 4 months and the incidence of tumors at this time was 100 per cent. When 30 per cent of Crisco or lard was given, the incidence of tumors at 6 months was 87 per cent.

These data demonstrate the fact that, in general, p-dimethylaminobenzene is more carcinogenic when the diet contains fat. They show further that the incidence of hepatomas is higher in rats given a diet containing 30 per cent corn oil than in those receiving a diet with 5 per cent corn oil. It is, therefore, apparent, that the level of the fat in the diet, as well as the type of fat, is important for the formation of hepatic tumors by p-dimethylaminobenzene. SAMUEL KAHN, M.D.

Khannolkar V. R., and Suryabai, B.: Cancer in Relation to Usages of New Types in India. *Arch. Path. Chlc.*, 1945 40 351

Three new types of cancer are found in different regions of India namely Bombay, Nagapatam,

patients, including the 6 who died developed marked symptoms and signs of involvement of the central nervous system. Surprisingly, the liver and spleen were rarely palpably enlarged in the early stages of the disease. Cephalin-cholesterol flocculation tests were positive in all of the patients at some time during their illness. Although the studies of the hepatic function were limited to those required by medical necessity all of the studies revealed less deviation from the normal than might have been expected. Essential pathological findings in the liver in the 6 fatal cases consisted of an acute autolytic process which was diffuse and most marked in the central and midzonal areas of the liver lobule. Little evidence of regeneration or repair was observed in these cases, presumably because of their brief and violent course.

There was no evidence that the disease had been transmitted by droplet infection to other patients in the ward. A laboratory worker who inadvertently drew up a mouthful of serum from a fatal case developed a mild form of the disease 10 days later. There is ample evidence that the preicteric phase of hepatitis may be detected clinically in these cases, as in the experimentally produced variety of the disease. In 1 case it was predicted that jaundice would develop on the basis of two positive cephalin-cholesterol flocculation tests on 2 different days. From this and similar observations it is believed that the cephalin-cholesterol flocculation test becomes positive long before clinical symptoms develop and is probably the earliest evidence of an impending acute hepatitis to be obtained in wounded men.

The authors could not be certain that these cases of severe hepatitis were due to what has been called homologous serum or transfusion jaundice. The incubation period corresponded closely to that seen in hepatitis following yellow fever vaccination and in experimentally produced serum jaundice. The average course prior to the development of serious symptoms in post vaccinal hepatitis is about 26 days, as contrasted to 3 or 4 days in this series. Two possibilities suggest themselves as to why the disease should follow so serious a course in the wounded men in this series: (1) that the amount of ieterogenic material was very much larger than that transmitted in vaccinal hepatitis or in experimental serum jaundice and (2) that the general nutritional depletion of the wounded men makes them especially vulnerable. The latter view seems the more reasonable.

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portance as specific treatment may save lives and shorten convalescence. JOHN L. LUNDQUIST M.D.

Dorogoch, J. R., and Tully, P. W.: The Relationship of Boeck's Sarcoid and Tuberculosis: Report of a Case in Which Tuberculosis of the Lymph Nodes was Associated with Features Highly Suggestive of Sarcoid. *Arch. Path., Chic.*, 1945 40:309.

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That this relationship may occur even though bacilli usually are not demonstrable in the lesions of sarcoidosis, is substantiated by the occurrence of the organism free "id" reactions of leprosy and mycotic infections, and the generally conceded relationship of streptococci to rheumatic fever and glomerulonephritis. SAMUEL KAHN M.D.

Kilne, D. E., Miller, J. A., Rusch, H. P., and Baumann, C. A.: Certain Effects of Dietary Fats on the Production of Liver Tumors in Rats Fed p-Dimethylaminoozobenzene. *Cancer Res.* 1946, 6:5

Six groups of 15 rats each were fed 0.06 per cent of p-dimethylaminoozobenzene for 4 months in synthetic diets containing: (1) no fat, (2) 5 per cent of corn oil, (3) 5 per cent of olive oil, (4) 50 per cent of corn oil, (5) 50 per cent of Crisco, and (6) 50 per cent of lard. Then a dye free diet was given for 5 months. A final incidence of liver tumors of 23 per cent was produced by the low fat diet, as compared with 94 and 53 per cent, respectively when the diet contained 5 per cent of corn oil or olive oil. When 50 per cent of corn oil was fed to the rats, large tumors were present before 4 months, and the incidence of tumors at this time was 100 per cent. When 50 per cent of Crisco or lard was given, the incidence of tumors at 6 months was 87 per cent.

These data demonstrate the fact that in general, p-dimethylaminoozobenzene is more carcinogenic when the diet contains fat. They show further that the incidence of hepatomas is higher in rats given a diet containing 50 per cent corn oil than in those receiving a diet with 5 per cent corn oil. It is, therefore, apparent, that the level of the fat in the diet, as well as the type of fat, is important for the formation of hepatic tumors by p-dimethylaminoozobenzene. SAMUEL KAHN M.D.

Khanolkar V. R. and Suryabai, B.: Cancer in Relation to Usages: 3 New Types in India. *Arch. Path., Chic.* 1945 40:351

Three new types of cancer are found in different regions of India, namely Bombay Visceroplasm

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and Patna. They may be called the dhoti chutta, and khaini cancers. They are associated with the wearing of a light garment (the dhoti) the smoking of a cigar (the chutta) with the lighting end in the mouth, and the depositing of tobacco and lime (khaini) behind the lower lip of the mouth. A histological study of the lesions which precede the development of two of these cancers reveals the similarity of appearance between them and the precancerous stages in mice which have been painted experimentally with carcinogenic substances.

The observations reported and a review of the available experimental literature on the subject of changes in the skin as a result of exposure to mechanical and thermal irritants lead to the conclusion that in the induction of the tumors described the part played by the reaction of the tissues which are the seat of the cancer is equal in importance to that played by the carcinogenic substances themselves.

Saphir, O., Appel, M., and Levinthal, D. H.: At-
tempts to Localize Tumor Metastases in the
Long Bones by Mechanical Trauma. *Cancer*
Res., 1945, 5, 771.

This experimental study was undertaken in order to ascertain whether or not trauma applied to the long bones might be influential in the localization of metastases from a transplanted malignant tumor. The Brown Pearce rabbit tumor, which is highly malignant and readily transplantable into the testes, was used throughout the study. Attempts were made to localize metastases in the long bones by a single mechanical trauma and by chronic irritation. Bone metastases have not been observed in the stock rabbits except in the spinal column, and then but rarely. In order to determine whether or not the Brown Pearce carcinoma grows in long bones transplants were made directly into the femur in 6 normal male rabbits. The tumor grew well within the marrow spaces in all, soon invaded the periosteum and adjacent muscles and metastasized extensively.

Trauma to the bones was produced by simple fracture of the humerus. In a series of 21 rabbits after an intravenous injection of a suspension of tumor cells was made into the ear vein. In a second series of 13 rabbits the humerus was fractured and 24 days later a similar injection was made. In a third series of 12 animals, the tumor was fractured and planted into the testes. Two weeks later after the testicular tumor was easily palpable, the humerus was fractured. In 2 other series chronic mechanical irritation was produced by implanting a small, rough piece of vitallium immediately beneath the tendon of the femur beneath the quadriceps tendon so that with each movement of the leg the metal rubbed against the bone. Six weeks later the intravenous or intratesticular transplantation of tumor was done. Only those animals that died of extensive tumor metastases were considered. Roentgenograms and autopsy studies of the material showed no evidence of tumor cells.

fracture sites or sites of mechanical irritation in any of the animals. It is concluded that mechanical trauma or chronic irritation of the bones played no role in the localization of metastases from transplanted Brown-Pearce carcinoma in rabbits.

JOHN L. LINDBQUEST, M.D.

DUCTLESS GLANDS

Keller, A. D., Lawrence, W. E., and Blair, C. B.: Effects of Varying Degrees of Hypophysectomy on the Dog. *Arch. Path.*, Chic., 1945, 40, 589.

Varying degrees of hypophysectomy were undertaken in dogs, and the animals were maintained for several months after the operation. During the latter stages of their survival, the status of their carbohydrate metabolism was assayed on a quantitative basis.

Sexual regression, cessation of growth and a marked change in coat were the only effects that could be reliably associated with the removal of the pars anterior per se. The lowering of the carbohydrate reserves, the occurrence and magnitude of the Housay effect and a decrease in adrenal function and size were associated with the progressive encroachment on the hypophyseal stalk, i.e., subsequent to total removal of the pars anterior and the posterior lobe. The greater the encroachment on the stalk, the greater were these deficits. These facts seem to indicate that the pars tuberalis normally elaborates (presumably in common with the pars anterior) the autacoids which are essential for the maintenance of these functions.

There was essentially no accumulation of fat in the livers of animals showing a nearly maximal Housay phenomenon. Obesity occurred following (1) hypophysectomy per se (2) lesions restricted to the hypothalamus (3) hypophysectomy plus encroachment on the hypothalamus and (4) section of the stalk plus encroachment on the hypothalamus. The obesity which followed hypothalamic involvement was definitely pathological, and that following hypophysectomy per se was also believed to have a pathological component. Obesity was not encountered when the surgical procedure was limited to section of the hypophysis or selective removal of the hypophyseal stalk.

In certain instances, in which there was gross infringement on the hypothalamus in addition to total removal of the hypophysis, the deficits in carbohydrate metabolism and adrenal function were submaximal or did not deviate materially from the normal. This suggests the possibility that endocrine principles are elaborated in the immediate environs of the hypothalamus, and that these principles have actions contrary to the actions of the known hypophyseal principles.

The term "hypophysectomy" therefore should not be used indiscriminately. In carrying out work to describe the type of hypophysectomy not only anatomically but

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functional results. In the anatomic examination the same attention should be focused on the amount of stalk remaining as on the remnants of the para anterior

SURVEY KARY M.D

EXPERIMENTAL SURGERY

Kinney, T. D., Haynes, F. W. and Dexter, L.: Experimental Production of Pulmonary Embolism by the Use of a Venous Catheter. *J. Lab. Clin. M.* 1945 3

To evaluate various methods of therapy for severe thermal burns in rats, the authors have devised a standard burn procedure. This has made it possible (1) to obtain reproducible survival rates (2) to preserve uninjured extremities (3) to eliminate the complication of trauma and hemorrhage from autoincision and (4) to preserve uninjured body orifices and permit the voiding of urine and defecation.

The success of the method is dependent on the standardization of all possible conditions. The Wistar rat was used as the test animal and kept under conditions of controlled temperature humidity and diet. The food and water intake after the burn had been given was also controlled.

A scald burn of the back was produced on anesthetized rats by immersion for 15 seconds at $90 \pm 0.25^\circ\text{C}$. A series of burns was produced from the base of the skull to the base of the tail, with the lateral and ventral burned area sharply demarcated and removed in order to calculate the percentage of total body surface burned. By varying the curvature of the back on immersion the burned

area can be varied from 45 to 10 per cent. In practice it was found that within this range 75 per cent of the surface burn could be reproduced within ± 2 per cent.

In order to obtain reproducible survival percentages for any given percentage of burn area, the initial weights of the burned rats were within a closely selected weight band. Two weight bands have been studied extensively: (1) from 200 gm. and (2) from 200 to 210 gm., and in these two groups all rats receiving burns of 50 per cent or more of the total body surface have survived within 48 hours while all rats receiving burns of 40 per cent or less of the total body surface have survived. The group receiving a burn between 40 and 50 per cent of their total body surface have a 34 per cent survival percentage for the entire weight groups of 54 per cent.

No significant difference was found in the relationship of the sex to survival.

Manipulation such as handling of the burned rat to obtain blood samples, markedly influenced survival. The 50 unhandled rats showed a 44 per cent survival while 50 which were subjected to intracutaneous samplings (7 per animal) showed a 34 per cent survival.

Reproducible survival rates depend on the control of all possible factors, such as the temperature of the bath, time in the bath, weights of the animals, finally seasonal variations for unburned controls. They cause a statistically significant difference in the cause of the sensitivity of the method to changes in any one of several variable factors. It is recommended that simultaneous controls always accompany the experimental groups.

HARRY S. AMES, M.D.

SURGERY

GYNECOLOGY AND OBSTETRICS

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OBSERVATIONS ON RADICAL SURGERY FOR LESIONS OF THE PANCREAS

ALLEN O. WHIPPLE, M.D., F.A.C.S., New York, New York

IT is now ten years since an effort (28) was begun to revive previous sporadic attempts at operating on malignant tumors involving the ampullar area and the pancreas. Since then considerable progress has been made in the evolution of the surgery of this region and organ. It is the purpose of this paper to discuss the factors that have made possible this progress and to call attention to mistakes to be avoided and to certain safety factors that have been found to insure a satisfactory result in the several procedures that can be used as indicated by the present pathology. The diagnosis of these lesions is not discussed in this paper.

The phase of surgery of the pancreas dealing with the removal of islet cell tumors for hyperinsulinism—a most interesting chapter in itself—had a determining influence in developing the radical surgery for malignant tumors. For it was demonstrated that with the use of silk for ligature and suture material with the delicate handling of tissue that such technique requires it was possible to carry out safely and with little reaction limited or extensive excision of pancreatic tissue. Thus the pre-existing dread of the pancreas as a source of surgeons was removed and the confidence of surgeons was increased in attacking the malignant lesions *en bloc*.

From the Department of Surgery, Columbia University, New York.

The history of previous efforts to deal radically with the tumors involving the duodenum, the common duct and the pancreas is worth reviewing because it emphasizes the grave dangers and the serious complications which deterred surgeons in the past from continuing attempts to deal with these lesions. It must be remembered that these surgeons did not know of the advantages of vitamin K blood transfusion and other shock prevention therapy and did not appreciate the significance of the principles of silk technique.

HISTORICAL REVIEW

The first successful attempt to remove an ampullar growth with excision of a segment of duodenum and a portion of the pancreas around the ampulla with implantation of the pancreatic and common duct in the line of suture of the repair of the duodenal defect was accomplished by William S. Halsted in 1899. His patient developed a stenosis of the common duct after 3 months was reoperated upon a choledochostomy being performed but died 6 months later. Autopsy revealed recurrent carcinoma in the head of the pancreas and duodenum.

Mayo-Robson in 1900 and Koerte in 1904 removed cylindrical segments of the duodenum including an ampullar carcinoma but the patients did not survive the procedure. In 1907 Desjardins described an operation for

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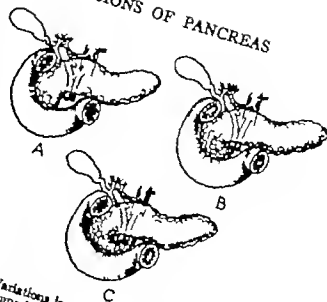


Fig. 1. Variations in extent of the uncinate process in relation to superior mesenteric vessels.

head which is described in the anatomy of the pancreas. This may be absent or be so developed as to encircle completely the superior mesenteric vessels and the portal vein (Fig. 1). Furthermore, its relation to those vessels, even as the duodenum with the head of the pancreas has been mobilized, is the superior mesenteric vessels as they pass over the terminal portion of the head of the pancreas to pass behind or surrounding them, done from the neck of the pancreas void injury to the superior mesenteric, and the terminal splenic vessels, each will make it possible to separate safely. This approach also facilitates identification of the pancreaticoduodenal and tributaries from the pancreatic bed.

Regarding the resections of the pancreas and chronic inflammation, uncontrollable pain the decision as to of the organ is to be removed is by the pathology as shown by films for calcification, and by the and induration are limited to tail the head of the organ with the duodenum be left intact. If the pathology is indicated with the same one stage as described for an ampullar neoplasia the pathology involves all parts of and duodenectomy is the operation will result in a diabetes of smaller doses of insulin of diabetes mellitus. A total pancreatectomy is indicated by several surgeons of months to warrant indications of leakage, during these radical pro-

cedures from the common duct and pancreatic duct, it is essential to establish adequate drainage of the denuded retroduodenal area. This is best accomplished by a good sized soft rubber tube with wide openings containing a smaller rubber tube to which continuous suction can be applied. The outer tube with several lateral openings prevents the suction tube from attaching itself to adjacent tissues and insures prompt and constant emptying of any exudate or secretions that otherwise would collect in the subhepatic space or Morrison's pouch. This has two other advantages: it prevents the soaking of the dressings with fluid that may have irritating and digestive action on the patient's skin; it makes it possible to measure the loss of fluid and electrolyte which in some cases may be 1 or 2 liters daily in the first week of the postoperative period.

PREOPERATIVE CARE

Measures to determine and to treat the cardiovascular, renal, and hepatic dysfunction are essential in all radical pancreatic surgery. The jaundice in many of these patients, if of several weeks' duration, may accompany renal and hepatic damage and in the older patients myocardial impairment is frequently present. Electrocardiographic studies are frequently indicated. Digitalis therapy. Nitrogen and dye retention as well as bladder retention due to prostatic hypertrophy require preoperative treatment. Prolonged prothrombin and clot

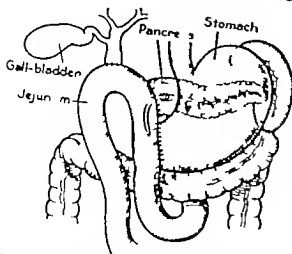


Fig. 2. Antecolic anastomoses with loop of jejunum.

ting time demand intensive vitamin K medication preferably by dysis. Failure of the prothrombin time to return to normal is an indication of severe liver damage and adds materially to the danger of the immediate postoperative period. It is advisable to give 25 000 units of penicillin every 4 hours for 24 to 36 hours before operation to combat gram positive bacterial infection in the operative field. Preoperative transfusion of blood is usually indicated. A Levin or Wangenstein tube should be placed in the stomach before operation to be used for suction after the operation.

ANESTHESIA

The choice of anesthesia is largely determined by the preoperative study. An experienced and skillful anesthetist is essential and he should be consulted as to the choice of anesthetic in the individual case. In our experience gas oxygen ether general or continuous spinal has given the most satisfactory and safe anesthesia. The radical operations are 4 hour procedures and require administration of anesthesia by skilled technicians as well as administration of supportive form of continuous infusion of saline infusions of 1500 cubic centimeters of the latter.

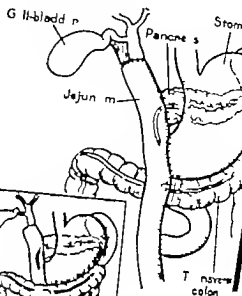


Fig. 3. Antecolic or postcolic anastomoses with loop of resected jejunum.

dicating the steps and stages of the operation. Certain points in the anatomy and technique will be discussed in more detail.

Incisions. The incision (Fig. 5) upon the procedure indicated. For the incision of the duodenum and head of the pancreas a right rectus incision from costal margin to the umbilicus gives adequate exposure and avoids the contamination of a long transverse incision. For resections of the entire jejunum or body and tail, or for exploring the jejunum for islet cell tumors the curved transverse incision above the umbilicus through the rectus abdominis and into the oblique muscles is essential. A left rectus incision is mentioned only as inadequate and handicapping.

QUESTIONS

2, 3, 4) showing surgical procedure.

The illustration shows three types

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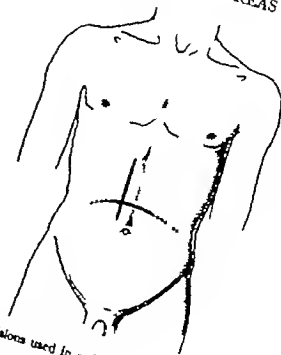
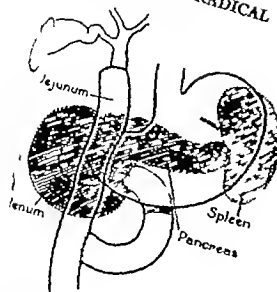


Fig. 5. Incisions used in radical resections of the pancreas.

anastomoses with vertical limb of resected jejunum following total pancreatectomy duodenojejunostomy

the duodenum to midline to determine the site of the head of the pancreas. A study of the emergence of the pancreatic vessels from behind the superior mesenteric vessels from behind the head of the pancreas is carried out to determine the site of the uncinate process and the degree of encirclement of the superior mesenteric vessels.

The common duct is separated from the portal vein in the gastrohepatic or hepatoduodenal ligament well behind the pancreatic duct and behind the duodenum where it is to be divided between the stomach and the duodenum.

The stomach is divided between the pylorus and the duodenum by Payr clamps.

The gastroduodenal artery is identified and the hepatic artery is identified which it arises from.

Depending upon the location and extent of the tumor and the presence or absence of the uncinate process the duodenum is divided proximal or distal to the duodenojejunostomy. If a carcinoma of the pancreas is present or if the tumor passes behind the superior mesenteric vessels great care must be used in dividing the duodenojejunostomy junction to the mesenteric root vessels.

In this exposure the inferior pancreaticoduodenal artery can be identified and ligated. The pancreas is now divided anteriorly at the junction of head and body and the splenic vessels and portal vein identified and the portal vein and superior mesenteric vessels carefully dissected away from the head of the pancreas. This is especially important if the uncinate process encircles the superior mesenteric vessels. The head of the pancreas is removed *en masse*. If the duodenum is divided proximal to the duodenojejunostomy an over and over suture and this closure buried with interrupted mattress or fine chromic continuous suture and this closure buried with interrupted mattress or fine chromic continuous suture and this closure buried with interrupted mattress or fine chromic continuous suture.

The distal cut end should be closed with interrupted silk. If the jejunum is divided distal to the duodenojejunostomy the jejunum is divided distal to the duodenojejunostomy and is brought up through the rent in the mesocolon to be used for the necessary anastomosis. If the duodenum has been closed either a loop of jejunum can be used anteriorly for the anastomosis or a vertical limb of the jejunum divided below the mesocolon can be brought up behind or in front of the mesocolon for the anastomosis to be followed by an end-to-side Roux-Y jejunostomy. The

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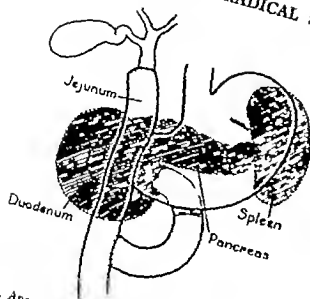


Fig. 4. Anastomoses with vertical limb of resected jejunum following total pancreaticoduodenectomy and splenectomy

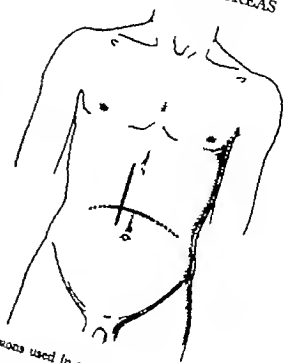


Fig. 5. Incisions used in radical resections of the pancreas

vation of the duodenum to midline to determine mobility of the head of the pancreas

3rd step A study of the emergence of the superior mesenteric vessels from behind the superior process of the uncinate process and the degree of its encirclement of the superior mesenteric vessels

4th step The common duct is separated from the portal vein in the gastrohepatic omentum or hepatoduodenal ligament, well below the cystic duct and behind the duodenum, where it is to be divided between clamps.

5th step The stomach is divided proximal to the pylorus between Payr clamps

6th step The gastroduodenal artery is ligated after identification of the hepatic artery from which it arises

7th step Depending upon the location and extent of the tumor and the presence or absence of an uncinate process the duodenum is divided proximal or distal to the duodenojejunal junction proximal if a carcinoma of the ampulla is present distal if a carcinoma of the head of the pancreas is present or if the uncinate process passes behind the superior mesenteric vessels. Great care must be used in freeing the duodenojejunal junction to avoid damage to the mesenteric root vessels

In this exposure the inferior pancreaticoduodenal artery can be identified and ligated

8th step The pancreas is now divided anteriorly at the junction of head and body and the splenic vessels and portal vein identified, and the portal vein and superior mesenteric vessels carefully dissected away from the head of the pancreas. This is especially important if the uncinate process encircles the superior mesenteric vessels. The head of the pancreas is removed *en masse*. If the duodenum is divided proximal to the duodenojejunal junction the distal cut end should be closed with an over and over silk or fine chromic continuous suture and this closure buried with interrupted mattress seroserosal sutures of interrupted silk. If the jejunum is divided distal to the duodenojejunal junction the distal cut end is used as the anastomotic limb and is best brought up through the rent in the mesocolon to be used for the necessary anastomoses. If the duodenum has been closed either a loop of jejunum can be used antecolically for the anastomoses or a vertical limb of the jejunum divided below the mesocolon can be brought up behind or in front of the colon for the anastomoses to be followed by an end-to-side Roux jejunojejunostomy. The

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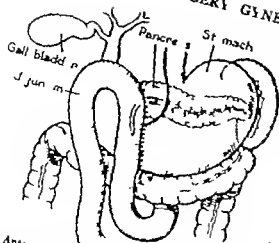


Fig. 2. Antecolic anastomoses with loop of jejunum.

ling time demand intensive vitamin K medication preferably by clysis. Failure of the prothrombin time to return to normal is an indication of severe liver damage and is an materially to the danger of the immediate postoperative period. It is advisable to give 25 000 units of penicillin every 4 hours for 24 to 36 hours before operation to combat gram positive bacterial infection in the operative field. Preoperative transfusion of blood is usually indicated. A Levin or Wangenstein tube should be placed in the stomach before operation to be used for suction after the operation.

ANESTHESIA

The choice of anesthesia is largely determined by the preoperative study. An experienced and skillful anesthetist is essential and he should be consulted as to the choice of anesthetic in the individual case. In our experience gas oxygen ether general or continuous spinal has given the most satisfactory results. The radical operations and safe anesthesia. The radical operations are 4 hour procedures and require administration of anesthesia by skilled technicians as well as administration of supportive intravenous fluids in the form of continuous drip saline infusion and 500 to 1500 cubic centimeters of matched blood transfusion during the latter part of the operation.

OPERATIVE TECHNIQUES

The illustrations (Figs. 2, 3, 4) showing the three types of one stage radical procedures in

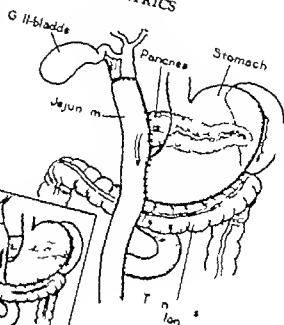


Fig. 3. Antecolic or postcolic anastomoses with vertical limb of resected jejunum.

dedicate the steps and stages of the operations. Certain points in the anatomy and techniques will be discussed in more detail.

Incisions. The incisions (Fig. 5) depend upon the procedure indicated. For the resection of the duodenum and head of the pancreas a right rectus incision from costal margin to the umbilicus gives adequate exposure and avoids the contamination of a long transverse incision. For resections of the entire pancreas or body and tail or for exploring the pancreas for islet cell tumors the curved transverse incision above the umbilicus through both recti and into the oblique muscles is essential. The left rectus incision is mentioned only to condemn it as inadequate and handicapping.

TECHNIQUE OF THE ONE STAGE PROCEDURE FOR CARCINOMA OF THE AMPULLAR REGION

Incision. Right rectus incision is made from near ensiform to below umbilicus.
1st step. Careful review of the head of the pancreas, duodenum gastrophatic omentum and liver is carried out to determine presence of metastases.
2nd step. Incision of the peritoneum is made to the right of the duodenum with ele

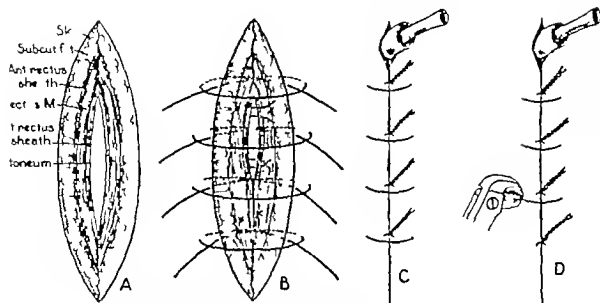


Fig. 6. Illustrations of repair of the incision and drainage tube to be used

wings (Figs. 2 and 3) illustrate these modifications.

9th step End-to-side gastrojejunostomy is performed.

10th step The dilated pancreatic duct is approximated into the jejunum above the gastrojejunostomy; a goiter or Carrel rubber tube being used to connect the pancreatic duct with jejunal mucosa through a 5 millimeter opening in the wall of the jejunum. The rest of the stump of the pancreas is to be tacked to the jejunal wall with interrupted silk sutures (Figs. 2 and 3).

11th step End-to-end or end-to-side choledochojejunostomy is performed depending upon the use of a loop or a limb of jejunum. A posterior layer of fine silk is used for seroserosal suture followed by an over-and-over continuous fine chromic suture to unite the mucosae and walls of the duct and jejunum, followed by the anterior seroserosal suture. If there is any tension whatsoever on its anastomosis the gall bladder or the hepaticoduodenal ligament should be tacked with interrupted silk sutures to the jejunal loop or limb to relieve tension. If a limb has been brought up behind the colon the rent in the mesocolon should be tacked to the vertical limb of jejunum to close the opening and prevent herniation. If a loop has been used

for the anastomoses the distal portion should be used for the gastrojejunostomy so as to avoid gastric contents from flowing over the common duct and pancreatic duct anastomoses.

12th step Peritoneal toilet sponge and pad count are made and a careful review of the hemostasis.

13th step The perforated rubber tube with inner suction tube is placed in the subhepatic area away from the anastomoses to collect seepage and leakage of bile etc.

14th step Near and far steel wire sutures through all layers of the abdominal wall with interrupted fine silk mattress sutures for peritoneum and posterior rectus sheath are placed and tied before the steel wire sutures are tied or twisted to approximate the edges of the incision (Fig. 6B). The wire sutures should be left in place for 12 to 14 days. The long segment of each wire suture should be cut at each end near the skin. (Fig. 6D). The next day the twisted wire can be removed easily.

It should be emphasized that a slow transfusion should be started as soon as the patient is found operable and continued during the procedure using if necessary 1000 to 1500 cubic centimeters of blood. It is a long trying operation and depending upon the build of the patient and the presence of fat in the upper

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abdomen and mesenteries the time of the procedure will vary from $3\frac{1}{2}$ to 5 hours.

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PRIMARY SUTURE OF NERVES

R. B. ZACHARY F.R.C.S. and W. HOLMES, M.A. D.Phil. Oxford, England

THE distinction between a primary and a secondary nerve suture is fairly generally understood, but the precise definition of the terms presents some difficulties. If a time limit is used the criterion for example, suture within 12 or 48 hours, some cases would be wrongly included from the group of primary sutures though the nerve repair were undertaken the time of the first surgical treatment of wound. In peace time this operation is usually done within a few hours but during the wound excision may not be done for 3 or more days when the direct local effects of the trauma are still in evidence and there has been no tissue repair. It is clear the environment of a sutured nerve at this stage is more closely allied to that which prevails in the immediate post-traumatic period than to the conditions obtaining when the wound has healed and a nerve repair performed in such circumstances would still be a primary nerve suture. For the purposes of this paper we define primary suture as the repair of a nerve through original unhealed wound at the time of the operative treatment of the wound itself.

The earliest record of nerve suture is of a repair of the median and ulnar nerves attempted by Baudens in 1836 (Létiot 1873). Contact of the suture material with the nerve was avoided to prevent necrosis and approximation of the nerve ends was accomplished by suturing the adjacent tissues. Unfortunately the patient died 8 days later and the nerve ends were found to have separated.

There is no evidence that the operation was repeated until nearly 30 years later then in 1862 more sutures were reported the first by Nélaton (Houel, 1864) the second by Laugier (1864). Both were primary sutures and in each case it was claimed

that motor and sensory recovery followed within a few days of operation. Howell and Huber (1893) collected records of 84 primary sutures they concluded that after primary suture the prognosis is favorable. Function will probably be restored completely or partially. They also added that after secondary suture the prognosis is good improvement is almost certain and in a large proportion of cases complete success may be expected. In comparing the results of primary and secondary suture they were concerned mainly with the problem of first intention healing of nerves. The view has been remarkably persistent that primary repair of nerves leads to healing by first intention and early clinical recovery at a rate incompatible with degeneration and regeneration of the distal trunk, and as late as 1923 at the International Congress of Surgery in London Henrikson reported such a case. But there is no doubt that in all examples of apparently immediate recovery many of which have come under our observation the sensory 'recovery is due to overlap from adjacent nerves and the motor recovery' to anomalous innervation or trick movements. The hypothesis of first intention healing is now exploded.

Another review of a series of primary sutures was that made by Sherren (1908) who examined 50 cases. Recovery of pain sensibility started between the 5th and 25th week, and touch sensibility between the 19th and 46th week the longer delay was in some cases ascribed to suppuration. He stated that restoration of tactile localization was not as a rule complete until more than 2 years after suture sometimes longer and that all cases uncomplicated by suppuration regained perfect sensibility. He found that motor power returned in about 1 year after suture of the ulnar nerve at the wrist and following suture at the elbow. He specified the quality of the suture material used in reviewing the older cases of

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performed at the London Hospital he found only one in which there had been no recovery—a patient whose wound became infected. Sherren advocated primary suture of divided nerves because the prognosis after secondary suture is more unfavorable.

Platt and Bristow (1923) in reviewing the late results of nerve injuries of the war of 1914-1918 refer to the extreme perfection attained after so called primary sutures and the incomplete type of recovery which is the rule in the majority of secondary sutures. They ascribe the difference to the type of lesion—the nerve was more seriously damaged in gunshot wounds and these all came into the class of secondary sutures.

Gonzalez Aguilar (1928) advocated suture as soon as possible after the myelin remains had been removed from the distal stump at the time when Schwann cells exhibited their maximum activity the optimum time for suture in his opinion is about 30 days after division of the nerve.

Herbig (1937) reported 4 primary nerve sutures; 2 were followed by complete recovery, 1 by improvement and there was 1 failure. In a series of 13 secondary sutures performed 2 to 12 months after injury 5 were cured and 8 improved there were no failures. His conclusion that primary suture gives the best results does not seem reasonable from these figures.

Platt (1937) refers to a series of 12 primary sutures. Although he does not give the results in detail he concludes that in primary sutures performed under ideal conditions complete recovery of motor power and recovery of protopathic sensibility at least is to be expected. In secondary sutures partial or complete motor recovery with imperfect restoration of sensation has been the rule. He advocates primary suture in small relatively clean wounds. In more extensive wounds with widespread bruising and multiple tendon injuries and in wounds in which infection has already secured a hold partial or complete failure after primary suture is almost inevitable.

Many other authors (Pollock and Davis 1933, Galile 1942) hold similar views but Mitchiner (1939) advises primary nerve

suture in gunshot wounds even in the presence of moderate infection.

During the Spanish Civil War Jolly (1942) carried out a number of primary nerve sutures but gave up this practice on the advice of Diaz who had found that the results of secondary nerve suture were better.

From the accounts of these authors it would appear that the chief factor militating against the success of a primary suture is infection and although many would hesitate to undertake primary nerve repair when in statement of Pollock and Davis that if primary nerve suture is performed and the wound remains clean and heals by primary intention we have taken advantage of the best possible conditions under which the end suture may be performed.

The investigation of nerve suture by animal experiments performed under aseptic conditions has shown that an optimal functional result is given by primary suture and that delay in repair progressively prejudices the quality of recovery. However the only primary sutures in man comparable with those carried out experimentally are those performed when a nerve is divided either accidentally or deliberately during the course of an operation. The conditions prevailing when suture is performed immediately after an incised lacerated or gunshot wound are different in many ways from those prevailing in an experimental or accidental operative section and the following analysis of the results of primary repair performed under a variety of conditions has been undertaken with a view to determining the policy to be adopted in the early treatment of divided nerves.

MATERIAL AND METHOD OF INVESTIGATION

Material. In this series are included all the cases of primary nerve suture which have come under observation at the Peripheral Nerve Injury Centre at the Wingfield Morris Hospital Oxford during the years 1940-1944. We have excluded all those in which the surgeon aimed at nothing more than a rough approximation of the stumps at the primary operation. There were 55 primary nerve

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TABLE I—PRIMARY NERVE SUTURES

Year	Site	Type of wound	Number	Total
Indian	High	Gunsbot	3	6
		Laceration		
	Low	Gunsbot		10
		Laceration	8	
Mal	High	Laceration		6
	Low	Gunsbot	6	
Mal	Forearm	Gunsbot	6	7
		operative		
	Wrist	Laceration		1
		Gunsbot		
Mal	Medial popliteal	Laceration		1
		Gunsbot		

2. The term "Laceration" includes lacerated or incised wounds.

ures in 49 patients. In 3 the nerve was usually divided at operation and immediate suture was undertaken. Fourteen were sutured during the primary treatment of gunsbot wounds and 38 during repair of incised or lacerated wounds. The ults in these cases demand special attention (Table I)

pattern and quality of recovery after suture depend to a certain extent on the involved and for this reason lesions of individual nerves will be considered separately before a final review is attempted. A variable factor that must be allowed in the analysis is the site of the lesion. Recovery after suture of the median or ulnar nerve in the arm is nearly always less satisfactory than after suture in the forearm and the results in these two nerves are therefore considered separately for high and low sutures. In the early days of this work those patients whose nerves had been sutured at the primary operation were not subjected to exploration unless there was some very good reason for doing so such as the absence of any sign of recovery long after it was due. Thus the cases in this group have been under observation for a considerable

time—up to 4 years—ample time for recovery to reach a stage at which it could reasonably be compared with that observed after secondary suture. More recently after it had been found that a number of primary nerve sutures had not been followed by satisfactory recovery the policy was changed and on a number of occasions exploration was undertaken at an early date. In 16 cases resection and resuture were performed. In some of the cases subjected to reoperation sufficient time had elapsed for recovery to be apparent and the quality of such recovery as had occurred will be indicated. To a certain number however exploration and resuture were undertaken before any clinical signs of regeneration could be expected and in these the data on which the assessments of the success, or otherwise, of the primary suture are based are histological—not clinical.

Clinical grading of recovery. In 1942 the Medical Research Council adopted a scheme for the assessment of recovery in peripheral nerve injuries suggested by Highet (Highet and Holmes, 1943). This system has a neurological basis, and motor and sensory recovery are considered separately. Although the scheme provides a valuable foundation it has been found necessary for our purposes to introduce certain intermediate grades in the assessment of ulnar, median and radial palsies. For example after a high lesion of the median nerve the recovery of slight power in the long flexor muscles is described as grade 1½ yet another patient who shows considerable strength in the long flexors but has not yet regained voluntary power is the not yet regained voluntary power is the thenar muscles comes into the same low category. Similarly with the ulnar nerve a patient who has recovered only slight voluntary power in the hypothenar muscles is classified as grade 2 which is the grading for another patient who has regained voluntary power in all the intrinsic muscles though not sufficient to act against resistance. It is necessary to introduce intermediate grades for each nerve and the following system has been adopted in this paper. It is presented at length herein since others may find the classification of use in the accurate assessment of recovery.

ULNAR NERVE

Motor Recovery

- M 0 No contraction in any muscles
 M 1 Return of voluntary power in the proximal (long flexor) muscles although they are not able to act against gravity
 M 1+ The proximal muscles act against gravity
 M 2 The proximal muscles are acting and there is a contraction in the hypothenar muscles at least with either no action in the interosseus or not more than a flicker
 M 2+ The proximal muscles and the intrinsic muscles are all acting and the first dorsal interosseus muscle produces a definite movement but does not act against resistance
 M 3 The long flexor muscles the hypothenars and the first dorsal interosseus act against resistance.
 M 4 As in grade 3 but some independent lateral movement of the fingers is possible
 M 4+ Recovery to grade 4 but the independent movement is good although not perfect.
 M 5 Complete recovery

Sensory Recovery

The subdivisions are the same as for the median nerve and will be dealt with under that heading

MEDIAN NERVE

Motor Recovery

- M 0 No contraction in any muscles
 M 1 A definite contraction in the proximal (long flexor) muscles but they do not act against gravity
 M 1+ The proximal muscles act against gravity but there is no return of power in the thenar muscles
 M 2 The proximal muscles act against gravity and there is a flicker in the thenar muscles
 M 3 The thenar muscles act against resistance
 M 4 All muscles act against strong resistance and some independent action is possible.
 M 5 Full recovery in all muscles

Sensory Recovery

- S 0 No recovery of sensibility in the autonomous zone of the median nerve
 S 1 Recovery of sensibility in the autonomous zone of the median nerve
 S 1+ Recovery of deep cutaneous pain sensibility within the autonomous zone of the median nerve
 S 2 Recovery of superficial pain sensibility
 S 2+ Recovery of superficial pain and some touch sensibility throughout the median area but with over response
 S 3 Recovery of pain and touch sensibility with disappearance of over response
 S 3+ Recovery as far as S 3 but localization of the stimulus is good and there is imperfect recovery of two-point discrimination.
 S 4 Complete recovery

RADIAL NERVE

Motor Recovery

- M 0 No recovery

- M 1 Return of voluntary power in the proximal muscles but not sufficient power to act against gravity
 M 1+ Return of power to the proximal muscles sufficient to act against gravity no return in the muscles acting on the thumb
 M 2 Return of voluntary power in the proximal muscles and the muscles acting on the thumb but the latter are not able to act against resistance
 M 3 Recovery to M 2 but abductor pollicis longus and extensor pollicis longus act against resistance.
 M 4 Proximal and distal muscles are acting strongly against resistance and some independent movement of the fingers is possible
 M 4+ Independent movement very good but not perfect.
 M 5 Complete recovery

Sensory Recovery

Intermediate grades as for median nerve may be used.

Although both motor and sensory recovery will be indicated in the tables giving the results of primary suture it is clear that for the ulnar and radial nerves motor recovery is the more important and should be used as the chief criterion for comparison, whereas for the median nerve good sensory recovery is of chief importance

One further point must be made clear before presenting the results. Previous authors have been impressed by the poor quality of recovery after secondary nerve suture as compared with primary which is not surprising if all secondary sutures are taken into account. Such a comparison is not of great value since it would include consideration of many nerve injuries for which primary suture would have been quite impossible for example those in which there was a large gap. It would also include many cases in which there was an unnecessarily long delay for recovery because at the primary operation the nerves were not seen to be divided and also in cases complicated by prolonged sepsis. Such delay leads to profound changes in the nerve, the end-organs and muscles, changes which adversely affect the quality of recovery. A better idea of the value of primary suture is obtained by comparing the quality of recovery with that seen after early secondary repair of lesions in which the gap was not so

TABLE I — PRIMARY NERVE SUTURES

Nerve	Site	Type of wound	Number	Total
Ulnar	High	Gunshot	3	4
		Laceration		
	Low	Gunshot		20
		Laceration	8	
Median	High	Laceration		7
	Low	Gunshot	6	
		Laceration	6	4
		operative		
Radial	Wrist	Laceration		11
		Gunshot		
		Laceration		

* The term "laceration" includes lacerated or lacerated wounds.

tures in 49 patients. In 3 the nerve was accidentally divided at operation and immediate suture was undertaken. Fourteen nerves were sutured during the primary treatment of gunshot wounds and 38 during the repair of incised or lacerated wounds. The results in these cases demand special attention (Table I).

The pattern and quality of recovery after nerve suture depend to a certain extent on the nerve involved and for this reason lesions of individual nerves will be considered separately before a final review is attempted. Another variable factor that must be allowed for in the analysis is the site of the lesion. Recovery after suture of the median or ulnar nerve in the arm is nearly always less satisfactory than after suture in the forearm and even separately for high and low sutures. In the early days of this work, those patients whose nerves had been sutured at the primary operation were not subjected to exploration unless there was some very obvious reason for doing so such as the absence of any sign of recovery long after it was due. Thus the cases in this group have been under observation for a considerable

time—up to 4 years—ample time for recovery to reach a stage at which it could reasonably be compared with that observed after secondary suture. More recently after it had been found that a number of primary nerve sutures had not been followed by satisfactory recovery the policy was changed and on a number of occasions exploration was undertaken at an early date. In 16 cases resection and resuture were performed. In some of the cases subjected to reoperation sufficient time had elapsed for recovery to be apparent and the quality of such recovery as had occurred will be indicated. In a certain number however exploration and resuture were undertaken before any clinical signs of regeneration could be expected and in these the data on which the assessments of the success, or otherwise of the primary suture are based are histological—not clinical.

Clinical grading of recovery. In 1942 the Medical Research Council adopted a scheme for the assessment of recovery in peripheral nerve injuries suggested by Hignett (Hignett and Holmes, 1943). This system has a neurological basis and motor and sensory recovery are considered separately. Although the scheme provides a valuable foundation it has been found necessary for our purposes to introduce certain intermediate grades in the assessment of ulnar median and radial palsies. For example after a high lesion of the median nerve the recovery of slight power in the long flexor muscles is described as grade M₁; yet another patient who shows considerable strength in the long flexors but has not yet regained voluntary power in the thenar muscles comes into the same low category. Similarly with the ulnar nerve a patient who has recovered only slight voluntary power in the hypothenar muscles is classified as grade 2 which is the grading for another patient who has regained voluntary power in all the intrinsic muscles, though not sufficient to act against resistance. It is necessary to introduce intermediate grades for each nerve and the following system has been adopted in this paper. It is presented at length herein since others may find the classification of use in the accurate assessment of recovery.

ULNAR NERVE

Motor Recovery

- M.0 No contraction in any muscles
 M.1 Return of voluntary power in the proximal (long flexor) muscles although they are not able to act against gravity
 M.1+ The proximal muscles act against gravity
 M.2 The proximal muscles are acting and there is a contraction in the hypothenar muscles at least with either no action in the interossei or not more than a flicker
 M.2+ The proximal muscles and the intrinsic muscles are all acting and the first dorsal interosseus muscle produces a definite movement but does not act against resistance
 M.3 The long flexor muscles the hypothenar and the first dorsal interosseus act against resistance.
 M.4 As in grade 3 but some independent lateral movement of the fingers is possible.
 M.4+ Recovery to grade 4 but the independent movement is good although not perfect.
 M.5 Complete recovery

Sensory Recovery

The subdivisions are the same as for the median nerve and will be dealt with under that heading

MEDIAN NERVE

Motor Recovery

- M.0 No definite contraction in any muscles
 M.1 A definite contraction in the proximal (long flexor) muscles but they do not act against gravity
 M.1+ The proximal muscles act against gravity but there is no return of power in the thenar muscles
 M.2 The proximal muscles act against gravity and there is a flicker in the thenar muscles
 M.3 The thenar muscles act against gravity
 M.4 All muscles act against strong resistance, some independent action is possible
 M.5 Full recovery in all muscles

Sensory Recovery

- S.0 No recovery of sensibility in the autonomous zone of the median nerve
 S.1 Recovery of deep cutaneous pain sensibility within the autonomous zone of the median nerve
 S.1+ Recovery of superficial pain sensibility
 S.2 Recovery of superficial pain and some touch sensibility
 S.2+ Recovery of superficial pain and touch sensibility throughout the median area but with over response
 S.3 Recovery of pain and touch sensibility with disappearance of over response
 S.3+ Recovery as far as S.3 but localization of the stimulus is good and there is imperfect recovery of two-point discrimination.
 S.4 Complete recovery

RADIAL NERVE

Motor Recovery

- M.0. No recovery

- M.1 Return of voluntary power in the proximal muscles but not sufficient power to act against gravity
 M.1+ Return of power to the proximal muscles sufficient to act against gravity no return in the muscles acting on the thumb
 M.2 Return of voluntary power in the proximal muscles and the muscles acting on the thumb but the latter are not able to act against resistance.
 M.3 Recovery to M.2 but abductor pollicis longus and extensor pollicis longus act against resistance
 M.4 Proximal and distal muscles are acting strongly against resistance and some independent movement of the fingers is possible.
 M.4+ Independent movement very good but not perfect.
 M.5 Complete recovery

Sensory Recovery

Intermediate grades as for median nerve may be used

Although both motor and sensory recovery will be indicated in the tables giving the results of primary suture it is clear that for the ulnar and radial nerves motor recovery is the more important and should be used as the chief criterion for comparison, whereas for the median nerve good sensory recovery is of chief importance

One further point must be made clear before presenting the results. Previous authors have been impressed by the poor quality of recovery after secondary nerve suture as compared with primary which is not surprising if all secondary sutures are taken into account. Such a comparison is not of great value since it would include consideration of many nerve injuries for which primary suture would have been quite impossible for example those in which there was a large gap. It would also include many cases in which there was an unnecessarily long delay for recovery because at the primary operation the nerves were not seen to be divided and also in cases complicated by prolonged sepsis. Such delay leads to profound changes in the nerve the end-organs and muscles, changes which adversely affect the quality of recovery. A better idea of the value of primary suture is obtained by comparing the quality of recovery with that seen after early secondary repair of lesions in which the gap was not so

TABLE II—PRIMARY SUTURES OF ULNAR NERVE IN ARM

Case No. File No. Age	Type of wound	Associated lesions	Primary nerve suture Time after injury	Depth	Site of suture	Galvanism	Recovery		Secondary operative findings
							Grade	Days after suture	
K-1	Operative	Tuberculosis of elbow	Status	—	At elbow	—	M +8 ++	4000	
W 84 30	Gunshot	—	48 hrs.	—	At elbow	+	M 8	1200	
1 B 73	Gunshot	Compound fracture of forearm	hrs.	—	Above elbow	+	M 8 +	1000	
6 of 36	Laceration	Muscle damage	hr	+	4 cm above medial epicondyle	+	M 8	4000	
5 D 8 20	Operative	Rupture of triceps	Status	—	At elbow	+	8 (Anomalous nerve supply)	650	
4 C 30 30	Gunshot	Muscle damage and median nerve division	A few hours	+	cm. above medial epicondyle	—	None	20	Separation of suture. Re-suture.

Further recovery probable.

large that it would have precluded primary suture. Some arbitrary classification must be made both as regards extent of the gap to be closed and the interval that elapsed before suture. For purposes of comparison we have thought it reasonable to use those secondary sutures performed within 6 months from the date of injury in which the gap was less than 6 centimeters. There must be few wounds in which primary nerve suture is feasible which are not fit for the secondary operation within six months.

RESULTS

Clinical Review

a Clinical review of results of primary nerve suture—High ulnar sutures (Table II) The quality of recovery after primary suture of the ulnar nerve above the elbow was not good but recovery of power in the intrinsic muscles of the hand is usually poor after high lesions, whether suture is performed early or late. In 2 of the 6 cases (1 and 3) the final stage of recovery had been reached—in Case 1 the result was moderate and in Case 3 poor.

Low ulnar nerve sutures (Table III) There were 20 cases in which the ulnar nerve was sutured in the forearm at the primary operation. In Cases 22 to 26 resection and resuture were performed before any appreciable re-

covery could have been expected. In Case 21 suture was of the sensory division only and one patient (Case 20) drowned before there was time for recovery to be well advanced.

The remaining 13 cases had sufficient time to show a considerable degree of recovery. Of these 2 (Cases 7 and 8) reached grade M₄ in which some independent lateral movement of the fingers was possible. One was a boy aged 7 years which is significant since it has become clear from a study of many nerve injuries that the rate of recovery is more rapid and the quality better in children than in adults. Two others reached grade M₃. Three patients recovered to grade M₂. In one of these an anomalous branch was found arising above the lesion and joining the nerve again below the site of division. The sparing of this branch might have enhanced the quality of recovery. In Case 13 the primary suture was performed at the Wingfield Morris Hospital and the lesion was re-explored 19 months later because recovery was not proceeding satisfactorily. There was a large neuroma at the site of suture.

In the remainder the recoveries were poor although in Cases 14, 15 and 16 the assessment must not be regarded as final.

Median nerve sutures (Table IV) There was only one primary suture of the median nerve

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TABLE III—PRIMARY SUTURES OF ULNAR NERVE IN FOREARM

Case No. File No. Age	Type of wound	Associated lesions	Primary nerve suture: Time after injury	Sepsis	Site of suture	Galvanization	Recovery		Secondary operative findings
							Grade	Days after suture	
7 H. 4 67	Gashot	Compound fracture ulna	6 hrs	—	0 cm. above platform	+	M. 4 S. 5	150	
8 B. 40 7	Laceration	Tendon damage	A few hrs.	—	Platform	+	M. 4 S. 3	870	
9 B. 14	Laceration	—	4 hrs.	—	1 cm. above platform	+	M. 3 S. +	300	
10 G. 16 66	Laceration	Tendon damage	A few hrs.	—	0 cm. above platform	+	M. 3 S.	300	
11 F. 13 30	Laceration	Tendon damage	4 hrs.	—	cm. above platform	+	M. 3 + S. (Anomalous branch)	770	
12 R. 13 40	Laceration	Median nerve lesion	hrs	—	cm. above platform	+	M. 3 + S. 3	300	
13 P. 7 33	Laceration	Tendon damage Median nerve lesion	3 hrs	—	1.5 cm. above platform	+	M. 3 + S. 3	300	
14 W. 33 37	Laceration	Tendon damage	A few hrs.	—	Wrist	—	M. 1 S. 5	400*	Re-exploration Large neuroma
15 K. 43	Laceration	Tendon damage	hr	—	0 cm. above platform	—	M. 4 S.	400*	
16 T. 38 30	Gashot	—	4 hrs	—	7 cm. above platform	—	M. 1 S. 1	400	
17 W. 7 41	Laceration	Tendon damage	A few hrs	—	5 cm. above platform	+	M. 1 S.	400	
18 P. 31 44	Laceration	Tendon damage Median nerve lesion	A few hrs	—	cm. above platform	+	M. 1 S.	400	
19 C. 47 41	Laceration	Tendon damage	hr	—	1 cm. above platform	+	M. 1 + S.	800	
20 J. 13	Laceration	Muscle damage	6 hrs.	—	1 cm. above platform	+	M. 1 + S.	800*	Died before recovery well advanced
21 S. 18 30	Laceration	Median nerve lesion	hrs.	—	Wrist	—	S. 3 (Partial suture)	10	Hard neuroma Resecture
22 C. 7 3	Laceration	Tendon damage	hrs	—	3 cm. above platform	None	None	5	Hard neuroma Resecture
23 C. 4 30	Laceration	Tendon damage	hr	Slight	3 cm. above platform	None	None	00	Hard neuroma Resecture
24 J. 4 3	Laceration	—	A few hrs.	—	Wrist	None	None	00	Hard neuroma Resecture
25 R. 60 6	Laceration	Tendon damage Median nerve lesion	3 hrs.	—	Mid forearm	None	None	65	Hard neuroma Resecture
26 D. 43 44	Laceration	Tendon damage	hr	+	Wrist	None	None	65	Hard neuroma Resecture

Further recovery probable.

TABLE IV — PRIMARY SUTURES OF MEDIAN NERVE

Case No. File No. Age	Type of wound	Associated lesions	Primary suture Time after injury	Depth	Site of suture	Recovery		Secondary operative findings
						Grade	Days after suture	
16 17 8 yd 38	Laceration	Muscle damage Ulnar nerv. lesion	hr	+	cm above medial epicon- dyle	M 3	400*	
16 16 16	Gnawed	—	3 hrs	—	Wrist	M 3 3+	1450	
19 20 3	Laceration	Tendon damage	A few hrs	—	Wrist	M 4 3 3+	800	
30 30 3	Laceration	Tendon damage	16 hr	—	cm above palm	3 3+ (normal own motor supply)	1400*	
31 R 13 40	Laceration	Tendon damage Ulnar nerve lesion	hrs	—	cm above palm	M 3 3 3	800	
3 L	Laceration	Tendon damage	hrs	—	5 cm above palm	M 3	800	
33 P 7 33	Laceration	Tendon damage Ulnar nerve lesion	3 hrs	—	5 cm above palm	M 3 3 3	300	
34 W 49 5	Laceration	—	A few hrs	—	Mid forearm	M 3 3+	30	
35 S 15 30	Laceration	Partial ulnar nerve lesion	hrs	—	Wrist	M 3 3+	1000	
36 C 33 9	Laceration	Tendon damage	6 hrs	—	Wrist	M 3	600	
37 Y 67	Laceration	Tendon damage	Irreparable	—	Wrist	M 3 3	100*	
38 P 53	Laceration	Tendon damage Ulnar nerve lesion	A few hrs	—	cm above palm	M 3	1000	
39 S 15 30	Laceration	Muscle damage	A few hrs.	—	Mid forearm	M 3	1100*	Hard neuroma Reaction
40 J 40 20	Laceration	Tendon damage	hrs	—	Wrist	M 3	100	Separation Reaction
41 M 40 18	Laceration	Tendon damage	hrs	—	Wrist	same	90	Separation Reaction
42 C 63 20	Laceration	Tendon damage	hrs	—	Wrist	same	90	Hard neuroma Reaction
43 G 4	Laceration	Tendon damage	hr	—	Wrist	same	45	Hard neuroma Reaction
44 R 60 42	Laceration	Tendon damage Ulnar nerve lesion	3 hrs	—	Mid forearm	same	10	Hard neuroma Reaction

Further recovery probable

above the elbow and there has not yet been time for recovery to be well advanced.

In 17 patients primary suture was performed on the median nerve in the forearm.

In 13 sufficient time had elapsed for substantial recovery to occur. In 3 the grade of recovery was very good with return of touch sensibility throughout the median area of a

TABLE V—PRIMARY SUTURES OF RADIAL NERVE

Case No. File No. Age	Type of wound	Associated lesions	Primary nerve suture Time after injury	Sepsis	Site of suture	Recovery		Secondary operative findings
						Grade	Days after suture	
45 D 5 26	Gunsbot	Compound fracture humerus	8 hrs.	—	13.5 cm. above medial epicon- dyle	M.4 S.	1000	
46 R 5 5	Gunsbot	—	24 hrs.	—	16 cm. above medial epicon- dyle	M.3 S.	1200	
47 H 41 20	Gunsbot	—	1 hrs.	+	0.0 cm. above medial epicon- dyle	M.3 S.	140*	
48 J	Gunsbot	Compound fracture humerus	2 hrs.	+	cm. above medial epicon- dyle	M.3 S 1	450*	
49 D 40 41	Gunsbot	Compound fracture humerus	3 days	+	18 cm. above lateral epicon- dyle	none	300	Separation of stumps. Resuture
50 R 3 20	Gunsbot	—	4 hrs.	—	0 cm. above lateral epicon- dyle	none	70	Hard neurotoma Resuture
51 J 4 25	Operative	—	Immediate	—	Elbow	none	40	Separation Resuture

*Further improvement probable.

degree sufficient to localize the stimulus and to distinguish the points of a compass less than 1 centimeter apart. One of the patients was a girl aged 5 years. In 3 others two-point discrimination and localization did not return so well but there was no over reaction to pin prick. In Cases 35 and 36 there were moderate sensory recoveries but in the remaining 5 recoveries were poor although further improvement might occur in 2. In 6 patients (including 2 mentioned above) the site of primary suture was explored and secondary suture undertaken. They will be considered later.

Radial nerve sutures (Table V) There were 7 cases of primary suture. In 5 sufficient time had elapsed for some degree of recovery to be apparent in 2 re-exploration and suture were performed at an early date.

Of the 5, 1 showed good recovery, 1 moderate, and 2 fairly poor. The last 2 may improve further since they have been followed for only 15 and 18 months respectively. There was one failure.

Sciatic nerve sutures (Table VI) In 3 patients the posterior tibial nerve was sutured at the primary operation with recovery of touch and pain sensibility but persistence of overreaction to pin prick. There was only 1

patient in whom the main trunk of the sciatic nerve was sutured at the primary operation. The site of suture was explored and resected before recovery could have occurred and this case is considered in the histological section.

There were no primary sutures after wounds involving the lateral popliteal nerve.

Comparison of results of primary and early secondary sutures The results of primary and early secondary sutures of the ulnar nerve above the elbow are shown in Table VII. Most of the gradings are not final but it does not appear likely that the results of the final comparison will be significantly different. In none was there motor recovery to grade M 3.

Low ulnar nerve sutures (Table VIII) have good and poor results in both groups, but it is clear that the general standard of recovery after secondary suture is better than after primary suture. Two out of 13 primary sutures had reached grade M.4 compared with 4 out of 12 secondary sutures. Four primary sutures had reached the stage at which the intrinsic muscles were acting against resistance (M 3) whereas 8 secondary sutures had reached this grade. Although there are 3 primary sutures in which further progress is likely, 4 secondary sutures should improve still further.

TABLE VI.—PRIMARY SUTURES OF SCIATIC NERVE

Case No. File No. Age	Type of wound	Associated lesions	Primary suture suturing Time after injury	Sepsis	Site of suture	Recovery		Secondary operative findings
						Grade	Days after suture	
(a) Males W 7 50	sciotic wound Laceration	Muscle damage	3 hrs.	+	Lower border of gluteus maximus	None	190	Separation, re- suture
(b) Females G 15 30	labial nerve Gunsheut	—	5 min.	—	Below motor branch	S	100	
54 S 4 24	Laceration	—	7 hrs.	—	4 cm. above medial condyle	S	100	
55 L 14 24	Gunsheut	—	7 hrs.	—	Partial division 5 cm. above medial condyle	S.2	1250	

Three of the 9 secondary sutures of the median nerve (Table IX.) reached a high grade of recovery compared with 3 out of 13 primary sutures. Six out of the 9 had reached grade S3 compared with 6 out of 13 primary sutures. The contrast between these two groups is not striking but the balance is in favor of the secondary sutures. Four of the latter have not yet reached their final stage and 3 primary sutures may show some improvement later.

The high quality of recovery after early secondary suture of the radial nerve is at once apparent (Table X.) Six out of 8 secondary sutures reached grade M4 compared with

one out of 5 primary sutures. Further improvement is likely in 2 secondary sutures and also in 2 primary sutures. Allowing for the recovery of these sutures to the next grade, the balance would still be strongly in favor of the early secondary sutures.

Two early secondary sutures of the posterior tibial nerve resulted in recovery of a similar grade to that after primary suture, but the value of comparing recoveries of this nerve is probably not great, on account of the difficulties in grading sensibility on the sole of the foot.

The comparison between recoveries after primary and secondary suture is set out in the histograms (Figs. 1, 2, 3) in which the motor or sensory recovery is plotted along the abscissa and the number of cases is plotted along the ordinate. The method has limitations since the time interval after suture is omitted, but an indication is given of the cases likely to show further recovery i.e. where the assessment was made less than six hundred days after operation.

Now that the data in each group have been presented we can depict the results in the whole clinical series in the form of a single composite histogram. For this purpose we have recorded the motor recovery of the ulnar and radial nerves and the sensory recovery of the median nerve on the same histogram. The result is shown in Figure 4, in which the more uniformly good results after early secondary suture are at once apparent. The number of recoveries to grade M4 or S3 after secondary suture is 16 out of 34 with 7 intermediate re-

TABLE VII.—COMPARISON OF PRIMARY AND EARLY SECONDARY SUTURES

High Ulnar Nerve Sutures					
Primary			Early Secondary		
Case No. File No.	Grade of recovery	Days after suture	File No.	Grade of recovery	Days after suture
K	M + S +	4000	S 7	M + S +	90*
			S 24	M + S	780
W 24	M S	130*	C 15	M S +	650*
S 22	M S	1900	E	M S	600
			C 30	M S	120
S 28	M S	490*			
D 18	S (Anconeus moun- tains)	690*			

*Further recovery probable

TABLE VIII.—COMPARISON OF PRIMARY AND EARLY SECONDARY SUTURES

Low Ulper Nerve Sutures

Primary				Early Secondary			
Case No. File No.	Galvanism	Recovery		File N	Galvanism	Recovery	
		Grade	Days after suture			Grade	Days after suture
7 H. 4	1/W for 6 M	M.4 S	200	M.4	+	M.4 S 2+	900
8 B.40	+	M.4 S.3	870	D. 7	+	M.4 S.3	630
				C.40	—	M.4 S.3	900
				W.53	1/W for 8 M	M.4 S.	360*
9 B.54	1/W for 6 M. 1/W for yrs.	M.3 S. +	300	M. 7	—	M.5 S.3	900
10 O.10	1/W for yr	M.3 S	300	A.3	+	M.3 S	320
				C.23	+	M.3 Sensory branch spared	340*
				O.27	+	M.3 S.3	720
F	1/W for 8 M.	M.4+8	900	B.55	—	M.3+8	340*
R. 3	+ yrs.	M.4+8.3	1300	Z.	+	M.4+S 2+	600
3 P.7	+	M.4+8.3	1200	S.73	+	M.4+8	340*
				C.10	—	M.4+8	180
4 W.38	—	M.3 S	400*				
5 K.1	—	M. S	450*				
6 T.28	—	M. S	360*				
7 W.1	—	M. S	400				
18 P.3	+	M. S	900				
9 C.47	+	M. S	1800				

* if other recovery probable.

coveries of lower quality. In the group of primary sutures 9 out of 39 had reached the same high grade with 9 other recoveries at an intermediate stage. However even in the incomplete recoveries the quality is higher in the early secondary sutures 9 out of 11 intermediate recoveries in the early secondary sutures had reached M 2+ or S 2 whereas none of the corresponding primary sutures had recovered so far.

c Associated factors. Why do these results not bear out the theoretical superiority of primary nerve suture over later repair?

What adverse factors may have impaired or prevented recovery?

Age. Two primary sutures were performed on children aged 7 and 5 years respectively (B.40 and O.10) and both resulted in a high grade of recovery. The influence of youth on the quality of recovery is shown by another case not in this series. A girl aged 9 years sustained a division of the median nerve which was repaired 3 years later. Eighteen months after operation there was recovery to M.4 S.3+ equal to that of the best primary suture. There were no children in the group of early

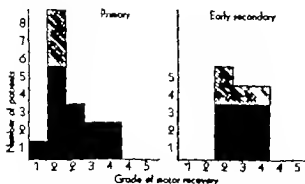


Fig. 1. Histogram showing recovery after primary and early secondary sutures of the ulnar nerve. In all histograms cross hatched area indicates intermediate grade of recovery; black area, final grade of recovery.

secondary sutures and with this exception, the ages in the two groups are comparable almost all being between 20 and 40. The results in this group of primary sutures have been enhanced by the inclusion of these two children.

The type of injury Of the 14 gunshot wounds in which primary suture was performed, 12 had sufficient time to show recovery. Three of these reached a high grade M-4 or S-3 and 4 others in grade M-2 or S-1 may still improve (Fig. 5).

Twenty-seven lacerated and incised wounds, similarly treated, showed 6 good recoveries (grade M-4 or S-3) and 5 in the lower groups may improve still more.

There is no conclusive evidence from these figures of any clear superiority of primary nerve suture in lacerated and incised wounds over that performed in gunshot wounds.

Sepsis Three primary sutures were followed by gross sepsis and at operation the

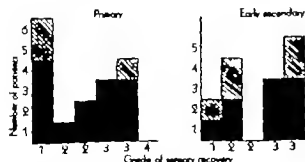


Fig. 2. Histogram showing recovery after primary and early secondary sutures of the median nerve.

TABLE IX.—COMPARISON OF PRIMARY AND EARLY SECONDARY SUTURES

Low Median Nerve Sutures					
Primary			Secondary		
Care No. 1 to No.	Grade of recovery	Days after suture	File No.	Grade of recovery	Days after suture
H ²⁹	M S 3+	1,450	M	M S 3+	900
O ²⁰	M S 3+	800	O 36	M S 3+	500*
O ²¹	S 3+	500*	H 35	S 3+	500*
H ²²	M S 3	1,800	C	M S 3	2000
C ²³	M S 3	200	D 27	M 4 S 3	2000
H ²⁴	M 3 S 3	1,300	F 17	M 3 S 3	1,050
H ²⁵	M S 3+	50			
H ²⁶	M 4 S 3+	000			
C ²⁷	M 3 S 3	200	H 14	M 3	200
H ²⁸	M S	200	D 26	M 3 S 3	900*
H ²⁹	M S	4,500*			
H ³⁰	M S	1,000*			
H ³¹	M 3 S 3	1,100			

*Further recovery probable.

sutured stumps were found to have separated. In 4 other cases the wound became infected to a moderate degree after the primary operation, but in none of these has recovery reached the final stage. Figure 6 shows the results after all those cases in which the wound be

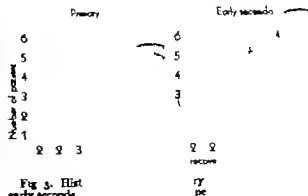


Fig. 3. Histogram showing recovery after primary and early secondary sutures of the median nerve.

TABLE V.—COMPARISON OF PRIMARY AND EARLY SECONDARY SUTURES

Radial Nerve Sutures

Primary				Early secondary			
Case No. P or S	Galvanism	Recovery		File No	Galvanism	Recovery	
		Grade	Days after suture			Grade	Days after suture
				N 3	S/W	M 3 S	600
				B 4	—	M 4+S 4	1550
				M 13	S/W	M 4+S 3	1400
				R 7	—	M 4+S	1100
				F 14	S/W	M 4+S	800
				F 5	—	M 4 S	850
45 D 5	—	M 4 S	1000	N 1	—	M 3 S 1	720
46 R 4	—	M 3 S	300	T 35	S/W	M 4+S 1	450*
47 H	+	M 4+S	340				
48 J 1	—	M 4+S 1	450*				
49 I	+ for 4/51	M S	300				

Further recovery probable.

came infected were eliminated. Although the results are better than when the infected cases are included, there is still a considerable proportion which have not reached a high grade of recovery.

Physical treatment. The two principal types of physical therapy which may have influenced recovery—and so far as we know only motor recovery—are passive movements to preserve joint mobility and electrical stimulation of the paralyzed muscles. The first is irrelevant since only 1 patient (P 21) had limited mobility of the joints of a degree sufficient to interfere with the function of the recovering muscles.

The influence of electrotherapy on the quality of recovery is very difficult to assess. Only those cases are available for comparison in which motor recovery is the criterion, namely ulnar and radial palsies. Fourteen out of 21 received electrotherapy but the intensity, frequency and duration of the treatment varied between such wide limits that it would be unreasonable to place too much reliance on the pooled results and in any subdivisions the numbers which were included in each instance would be statistically insignificant.

The histogram (Fig 7) shows no evidence of a significant effect of galvanism on the quality of recovery in these primary sutures.

It is clear that the factors we have discussed do not fully explain the failure of such a large proportion of primary nerve sutures to reach a high grade of recovery.

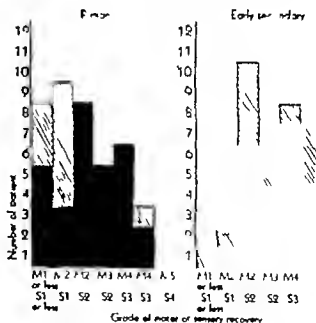


Fig. 4. Histogram showing recovery after primary and early secondary sutures of ulnar, median, and radial nerves.

ZACHARY ET AL. PRIMARY SUTURE OF NERVES

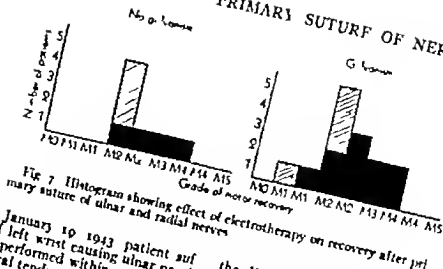


Fig. 7. Histogram showing effect of electrotherapy on recovery after primary suture of ulnar and radial nerves

CASE 23. G-42 January 19 1943 patient suffered a laceration of left wrist causing ulnar paralysis. Operation was performed within 1 hour. The ulnar nerve and several tendons were sutured. The patient was fixed in palmar flexion for 3 weeks. The patient was admitted to the Wingfield Morris Hospital. No recovery for 3 weeks. May 1943 operation was performed under general anesthesia. There was a fusiform neuroma on the ulnar nerve surrounded by dense scar tissue. Measurements were 2.5 by 1.0 by 0.8 centimeter. Stimulation produced no motor response. Resection and anastomosis were performed. Histology. The specimen was examined in transverse section at five levels. A good reunion has been separated by less than 4 millimeters and the gap along the long axis of the nerve with a very small proportion of scar tissue (contrast Case 22). But there is gross abnormality of the endoneurium of the nerve bundles in the distal trunk, for over a length of about 10 millimeters immediately below the suture line the endoneurial connective tissue is formed of a dense network of thick collagenous fibers (Fig. 8 and 9). This fibrosis is of varying severity but at almost all points in the nerve it is greatly exuberant as compared with the condition found after 4 months of uncomplicated Wallerian degeneration. This is clearly shown by the transverse section at the extreme distal end of the specimen where the nerve sheath shows the normal structure of a 4 months degenerated stump. The contrast between the two levels is well shown even at a low power of magnification (c.f. Figs. 10b and 10c). No myelinated nerve fibers are visible 3 millimeters below the suture line. Conclusion. A good reunion at the site of primary suture but with severe endoneurial collagenization in the distal trunk immediately below the suture line. This abnormality would certainly have produced a permanent bar to the regeneration of normal fibers.

CASE 24. J-41 January 5 1944 patient received laceration of the left wrist causing ulnar paralysis. Primary suture of ulnar nerve occurred within a few hours. The wrist was held in a flexed position by plaster. March 28 1944 patient was admitted to the Wingfield Morris Hospital. There was complete ulnar paralysis below the dorsal cutaneous nerve. Electromyogram of hypothenar muscles gave no evidence of reinnervation. April 19 1944 operation was performed under local anesthesia. The wound scar was continuous with that of the divided tendon of the flexor carpi ulnaris and the scar immediately around the nerve. The proximal portion measured 1.5 by 0.8 by 0.5 centimeter. The thick suture material could be seen emerging from the posterior aspect of the neuroma. Resection and anastomosis were performed. Histology. The longitudinal section through the suture line (Fig. 11) shows that the stumps are not far separated but that the path of regeneration is completely obstructed by numerous masses of suture material surrounded by granulation tissue and mature collagen. Conclusion. Reunion was prevented by fibrosis at suture material between the stumps.

CASE 25. D-43 December 29 1943 patient received a laceration of the left wrist by glass. Tourniquet was applied and removed at the hospital 35 minutes later. Immediate operation was performed and the flexor carpi ulnaris and ulnar nerve were found to be divided. Both were sutured with the wrist flexed and the position was maintained by plaster for 3 weeks. February 28 1944 patient was admitted to the Wingfield Morris Hospital. Examination revealed possibly a flicker of activity in the hypothenar muscles. The latter and the first dorsal interosseous responded to farad and sensory response. There was complete sweating operation was performed under local anesthesia. A band of scar extended down from the skin across the nerve just distal to a small neuroma. The latter measured 1.0 by 0.8 by 0.5 centimeter and the latter irregularly firm but not hard. Stimulation below the lesion gave no motor or sensory response. Histology. The proximal and distal trunks lie close together but they are not opposed to each other (Fig. 12). Thus the outgrowths from the

the Wingfield Morris Hospital. There was complete ulnar paralysis below the dorsal cutaneous nerve. Electromyogram of hypothenar muscles gave no evidence of reinnervation. April 19 1944 operation was performed under local anesthesia. The wound scar was continuous with that of the divided tendon of the flexor carpi ulnaris and the scar immediately around the nerve. The proximal portion measured 1.5 by 0.8 by 0.5 centimeter. The thick suture material could be seen emerging from the posterior aspect of the neuroma. Resection and anastomosis were performed. Histology. The longitudinal section through the suture line (Fig. 11) shows that the stumps are not far separated but that the path of regeneration is completely obstructed by numerous masses of suture material surrounded by granulation tissue and mature collagen. Conclusion. Reunion was prevented by fibrosis at suture material between the stumps.

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TABLE XL.—RATE OF JOINT EXTENSION AFTER SUTURE

Case No File No	Joint	Degree of Joint flexion	Immobilization
C 30	Elbow	Flexed	Several weeks
J 12	Wrist	Flexed	8 weeks
M 40	Wrist	Full	8 weeks
D 40	Elbow	Flexed 120°	8 weeks
J 11	Elbow	Flexed	8 weeks
K 71	Knee	Flexed 60°	25 weeks 3 weeks un- lockable

proximal and distal bundles have largely failed to unite. A few fine axons only are to be found in the nerve below the suture line.

Conclusion Poor reunion as a result of inaccurate apposition of the stumps or rotation after suture.

CASE 35. R.60 (age 62 years) May 22 1944, patient suffered laceration of the right forearm dividing median and ulnar nerves. Primary suture of nerves was done within 3 hours. September 8 1944 patient was admitted to the Wingfield-Morris Hospital. No recovery. Although recovery was not unduly delayed it was decided to explore the lesions. September 9, 1944, operation was performed under local anesthesia. The ulnar nerve was found embedded in dense scar and adherent to tendons. The neuroma measured 4.0 by 1. by 0.5 centimeter and its consistency was hard. Trial section of the site of suture revealed dense scar. Resection and resuture performed.

Histology The proximal and distal bundles at the site of suture are separated by a gap of about 7 millimeters and this is filled with dense scar tissue. Very little Schwann-tissue unites the two stumps, so that the distal nerve is poorly reinnervated, and contains only a few very fine axons.

Conclusion Very poor reunion, and separated by a gap filled with scar tissue.

CASE 4. C 63 January 3 1943 patient suffered a laceration of the right wrist. Operation was performed within 3 hours. The median nerve and several tendons were severed. The tendons were repaired and the ends of the median nerve trimmed and sutured with the wrist flexed. The wrist was immobilized in plaster for 4 weeks. March 10, 1944 patient was admitted to the Wingfield-Morris Hospital. No recovery. March 31 1944 operation was performed under general anesthesia. There was a hard neuroma measuring 2.0 by 1.0 by 0.5 centimeter. Stimulation of the nerve above the lesion produced no response in the thenar muscles. Re-section and resuture performed.

Histology The specimen consists of a fusiform neuroma with considerable epineurial scar which

increases as the site of suture is approached. Suture material is visible near the proximal and distal ends of the resected segment—an indication that some separation had probably occurred. The columns of Schwann cells at the suture line and the distal bundles are widely separated by scar tissue. In addition there is a dense collagenization of the endoneurium of the distal trunk over a length of a few millimeters below the suture line (see Case 23, Fig 8). No myelinated fibers are present in the distal nerve bundles.

Conclusion A poor union with separation and fibrosis and with abnormality of the endoneurium immediately distal to the suture line.

CASE 43. G.46 September 1943 patient received a laceration of the right wrist. At operation 13½ hours later the radial artery and superficial radial nerve, several tendons and the median nerve were found to be divided. The tendons were repaired and the median nerve and the median nerve line sutured. September 14 1943, patient was re-admitted to the Wingfield-Morris Hospital. October 13 1943, operation was performed under local anesthesia. A hard fusiform neuroma on the median nerve measured 1.4 by 1.0 by 0.5 centimeter. Stimulation below the lesion produced no sensory response and the lesion was resected and resutured.

Histology The distance between the proximal and distal bundles is small, about a millimeter. The outgrowth from the proximal bundles can be seen spreading out fanwise into a bed of granulation tissue in which the collagenous elements are disoriented and become denser as the distal bundles are approached. The outgrowth from the two stumps is not toward each other but to opposite sides of the specimen (cf Case 26) an indication of poor apposition at the time of primary suture. There are numerous foreign body giant cells well toward the center of the lesion, and clearly associated with suture material. No axons are visible in the distal bundles, which they would undoubtedly have reached after 4 weeks had the suture been successful.

Conclusion A poor union as a result of faulty apposition.

CASE 44. R.60 May 22 1944 patient received a laceration of the right forearm with division of median and ulnar nerves. Primary suture of nerves was done within 5 hours. September 8 1944, patient was admitted to the Wingfield-Morris Hospital. No recovery. September 9 1944, operation was performed under local anesthesia. The median nerve was surrounded by dense scar. The neuroma measured 2.7 by 0.6 by 1.0 centimeter and was hard. Trial section revealed only one good bundle. Re-section and resuture were performed.

Histology This gap separating the proximal and distal bundles is small, but the intermediate zone consists largely of dense masses of collagen with some aggregations of inflammatory cells. Through this scar tissue there has been only slight reunion of the stumps and the distal trunk contains no myelinated fibers. Some of the bundles contain many

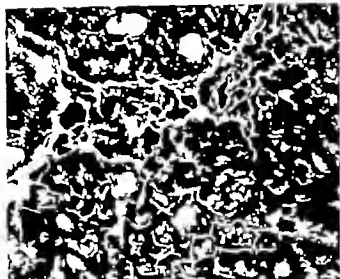


Fig. 8. Case 23. Detail of the endoneurium in a nerve bundle about 8 millimeters distal to the suture line. Most of the Schwann tubes are very small in diameter and are surrounded by dense blocks of collagen. Masson, $\times 645$.

axons, but others few or none. The endoneurium of the distal bundles shows an excess of collagen immediately below the suture line.

Conclusion. A poor reunion with grossly excessive scarring between the stumps.

CASE 30. S 55. June 20, 1942, patient suffered a laceration of the right forearm. Operation was done within a few hours. The median nerve was found divided in the middle third of the forearm. It was sutured with fine silk after trimming. Plaster was applied with the elbow flexed 90 degrees and wrist flexed 45 degrees and maintained for 2 months. August 25, 1942, patient was admitted to the Wingfield Morris Hospital. Complete median paralysis below branches to long flexors. Daily physiotherapy started including galvanism to the thenar muscles. July 3, 1943, the only signs of recovery were a flicker in abductor pollicis brevis and a slight decrease in the area of analgesia. Operation was

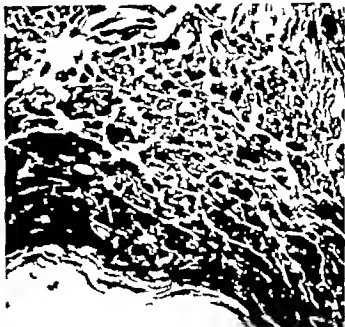


Fig. 9. Case 23. Detail of the endoneurium in a bundle about 6 millimeters distal to the suture line. Similar to Figure 7 but the endoneurial collagen is even more dense, and the Schwann tubes hardly distinguishable. Masson, $\times 670$.

performed and a neuroma measuring 2.5 by 1.5 by 1.0 centimeter its proximal part soft but the distal portion very firm was found. Stimulation produced a motor and sensory response, but in view of the consistency of the lesion it was decided to resect and resuture.

Histology. The lesion consists of a fusiform swelling composed largely of nervous tissue. The proximal and distal bundles are connected by tissue consisting of abundantly reinnervated Schwann tubes (Fig. 13) with only slight excess of connective tissue. The distal bundles are uniformly innervated by small myelinated fibers (Fig. 15) except for half of one bundle in which myelinated fibers are deficient. Myelinated fibers are as numerous at the



Fig. 10. Case 23. Low power views of transverse sections of the nerve. a, immediately proximal to the suture line. b, 10 millimeters distal to the suture line. c, at the extreme distal end of the specimen, about 15 millimeters

distal to the suture line. a and c show normal proximal and distal nervous tissue respectively but in b the excessive endoneurial collagenization is manifested in most of the bundles by their deep staining. Masson, $\times 13$.

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Fig. 24. Case 24. The specimen in longitudinal section showing the site of suture. *P* Proximal nerve bundles, *D* distal nerve bundles. *S* remains of suture material and associated scar—many similar masses can be seen as well as those indicated by pointers. $\times 3.7$

distal level as at the proximal level above the suture line though they have not yet returned to a normal diameter (cf. Figs. 14 and 15).

Conclusion. Apparently a good reunion. The histological report casts considerable doubt on the wisdom of resection and resuture in this case, and it seemed reasonable to accept the specimen as showing good union and good reinnervation. However one year after secondary suture the patient had regained strong action in abductor pollicis brevis and there was touch and pain sensibility to the tips of the digits with no over reaction to pin prick. Thus a later secondary suture had proved superior to a primary suture in which histological examination showed an apparently successful union.

CASE 51. R 51. March 19, 1943. Patient received a gunshot wound of the left arm soft tissue wound. Radial palsy. Operation was performed 5 hours later. Extension of wound nerve almost completely severed. Small piece of bruised nerve was excised from distal end. Nerve sutured with silk. The wound closed with gauze drainage. April 7, 1943.



Fig. 25. Case 25. The specimen in longitudinal section showing the site of suture. *P* Proximal nerve bundles, *Ro* area of regeneration, *D* distal nerve bundles, *D.o* distal nerve bundles. *D* area of Schwannian and mesodermal outgrowth from the distal bundles. \times



Fig. 30. Case 30. The specimen in longitudinal section showing the site of suture. *P* Proximal nerve bundles, *S* few fragments of suture material. Nervous tissue the form of small bundles. Only a few neurolemmal areas, in continuous past the suture line. $\times 3.5$.

patient was admitted to the Wingfield Morris Hospital May 25, 1943. Operation was performed under general anesthesia. A neuroma 1.5 centimeters long, firm consistency was found. The distal trunk felt section of neuroma and 4.0 centimeters of the distal trunk were done, leaving gap of 7.0 centimeters. Suture was performed.

Histology. The longitudinal section of the specimen showed that the stumps were well apposed and reasonably close together. In the intervening area, however, there has been a considerable irregular proliferation of fibroblasts with a deposition of young collagen. This has caused a lateral diversion of some of the outgrowth of nervous tissue from both stumps with some neuroma formation (Fig. 16). Yet many regenerating fibers have reached the distal nerve distal to the suture line. The reinnervated Schwann tubes are widely separated from each other giving the appearance of gross edema. The significance of this change is uncertain but if such endoneurial edema is followed by fibroblast proliferation in the spaces it is an abnormality which would have had an adverse effect on recovery.

Conclusion. A fairly good junction but with some failure of union of the stumps and gross edema in the distal endoneurium.

Summary of histological findings. There were 5 chief histological abnormalities in these specimens sometimes more than one abnormality was evident in a single specimen.

1. Faulty apposition the proximal and distal bundles were directed toward different sides of the nerve.
2. The presence of suture material between the sutured stumps.

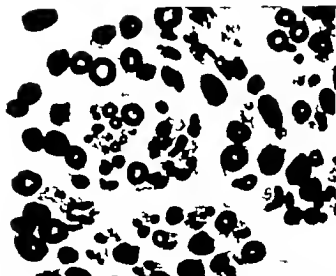


Fig 14. Case 30. Part of a nerve bundle in a transverse section at the proximal end of the specimen, showing the condition of the nerve fibers above the suture line. Myelin sheath stain. $\times 560$.

3 Scar between the nerve ends. The amount of scar tissue between the sutured stumps was variable but in several cases greatly excessive and clearly hindering regeneration.

4 Excessive endoneurial fibrosis was frequently noticed particularly in the distal stump immediately below the suture line. In some cases it was so excessive that satisfactory regeneration would have been impossible.

5 Separation of the sutured stumps.

The first two faults are due to poor technique in which the suturing has been inaccurate. The third and fourth are probably due to inadequate excision of the damaged nerve ends. This can hardly be classed as faulty technique since the fibrosis between and within the bundles would not be present at the time of the primary operation and we do not yet know how to recognize macroscopically the changes that will lead to excessive collagen formation within the nerve stumps. It is also possible that excessive postoperative tension on the nerve could be held responsible.

The separation of the sutured stumps may be due to unduly rapid extension of the joint which was flexed to approximate the nerve ends or else due to excessive tension at the time of operation or possibly sepsis. But of the 6 cases in which separation occurred

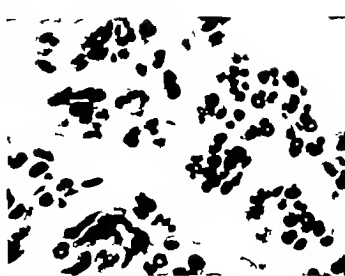


Fig 15. Case 30. Part of a nerve bundle in transverse section at the distal end of the specimen, showing the condition of the nerve fibers below the suture line. Myelin sheath stain. $\times 560$.

there was only 1 in which the extension of the joint had been unduly rapid (Table XI). Sepsis was present in only 2 cases and undue tension at operation must be considered to be the cause of separation in the other sutures.

DISCUSSION

The first conclusion arising out of these records is that contrary to the widely accepted view the best results of primary nerve suture do not approach nearer to perfection than the best results of early secondary suture. Indeed, considering only those cases in which there has been adequate time for recovery the proportion of good results is higher in the early secondary sutures in this series. The scales are weighted still more against the primary sutures if we take into account those in which re-exploration and



Fig 16. Case 31. The specimen in longitudinal section showing the site of suture. P Proximal nerve bundle, D distal nerve bundles. $\times 4$.

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Fig. 4. Case 4. The specimen in longitudinal section, showing the site of suture. P Proximal nerve bundles, D distal nerve bundles, S remains of suture material and associated scar—many similar masses can be seen as well as those indicated by pointers. X-37

distal level as at the proximal level above the suture line, though they have not yet returned to a normal diameter (cf. Figs. 4 and 15).

Conclusion Apparently a good reunion. The histological report cast considerable doubt on the wisdom of resect on and resuture in this case, and it seemed reasonable to accept the specimen as showing good union and good reinnervation. However one year after secondary suture the patient had regained strong action in abductor pollicis brevis and there was touch and pain sensibility to the tips of the digits with no over reaction to pin prick. Thus a later secondary suture had proved superior to a primary suture in which histological examination showed an apparently successful union.

CASE 51: R-31 March 19 1943 patient received a gunshot wound of the left arm soft tissue wound. Radial palsy. Operation was performed 5 hours later excision of wound, nerve almost completely severed. Small piece of bruised nerve was resected from distal end. Nerve sutured with silk. The wound closed with gauze drain. April 7 1943



Fig. 5. Case 50. The specimen in longitudinal section showing the site of suture. P Proximal nerve bundles, Ro area of regenerative outgrowth from the proximal bundles, D distal nerve bundles, D.O area of Schwanian and mesodermal outgrowth from the distal bundles. X-4.

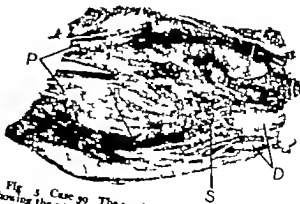


Fig. 6. Case 59. The specimen in longitudinal section, showing the site of suture. P Proximal nerve bundles, D distal nerve bundles, S a few fragments of suture material. Nervous tissue, in the form of small bundles with only a few neurolemmal areas, is continuous past the suture line. X-35

patient was admitted to the Wingfield Morris Hospital, May 25 1943 operation was performed under general anesthesia. A neuroma 15 centimeters long firm consistency was found. The distal trunk felt firm for 4 centimeters distal to the neuroma. Resection of neuroma and 4.0 centimeters of the distal trunk were done leaving gap of 7.0 centimeters. Suture was performed.

Histology The longitudinal section of the specimen showed that the stumps were well apposed and reasonably close together. In the intervening area however there has been a considerable irregular proliferation of fibroblasts with a deposition of young collagen this has caused a lateral diversion of some of the outgrowth of nervous tissue from both stumps with some neuroma formation (Fig. 16). Yet many regenerating fibers have reached the distal nerve distal to the suture line the reinnervated Schwann tubes are widely separated from each other, giving the appearance of gross edema. The significance of this change is uncertain, but if such endoneurial edema is followed by fibroblast proliferation in the spaces it is an abnormality which would have had an adverse effect on recovery.

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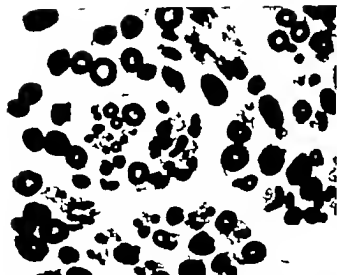


Fig. 14. Case 39. Part of a nerve bundle in a transverse section at the proximal end of the specimen showing the condition of the nerve fibers above the suture line. Myelin sheath stain. $\times 560$.

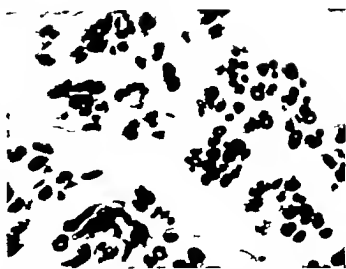


Fig. 15. Case 39. Part of a nerve bundle in transverse section at the distal end of the specimen showing the condition of the nerve fibers below the suture line. Myelin sheath stain. $\times 560$.

3 Scar between the nerve ends. The amount of scar tissue between the sutured stumps was variable but in several cases greatly excessive and clearly hindering regeneration.

4 Excessive endoneurial fibrosis was frequently noticed particularly in the distal stump immediately below the suture line. In some cases it was so excessive that satisfactory regeneration would have been impossible.

5 Separation of the sutured stumps.

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The separation of the sutured stumps may be due to unduly rapid extension of the joint which was flexed to approximate the nerve ends or else due to excessive tension at the time of operation or possibly sepsis. But of the 6 cases in which separation occurred

there was only 1 in which the extension of the joint had been unduly rapid (Table VI). Sepsis was present in only 2 cases and undue tension at operation must be considered to be the cause of separation in the other sutures.

DISCUSSION

The first conclusion arising out of these records is that contrary to the widely accepted view the best results of primary nerve suture do not approach nearer to perfection than the best results of early secondary suture. Indeed considering only those cases in which there has been adequate time for recovery the proportion of good results is higher in the early secondary sutures in this series. The scales are weighted still more against the primary sutures if we take into account those in which re-exploration and



Fig. 16. Case 51. The specimen in longitudinal section, showing the site of suture. P Proximal nerve bundle D distal nerve bundle. $\times 4$.

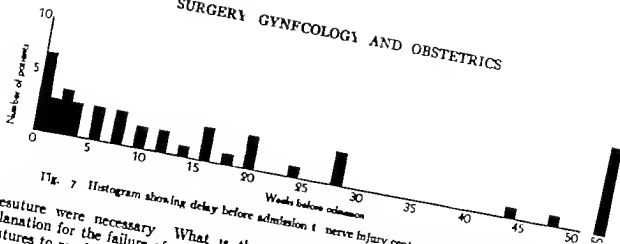


Fig. 7 Histogram showing delay before admission to nerve injury center after primary nerve suture.

resuture were necessary. What is the explanation for the failure of so many primary sutures to reach the expected high standard?

It has been all too readily assumed in the past that if infection can be avoided after primary nerve suture the result should be good. Although in a few of the cases recorded above sepsis may have been an adverse factor there are many in which the wound healed without sepsis and yet the recovery was poor.

We have no evidence that the results in this group of primary sutures have been unfavorably influenced by lack of physical therapy. Indeed, an unduly favorable effect has probably resulted from the inclusion of two children in the series. We must, therefore, assume that the quality of surgical repair which is possible at the time of the primary operation is a factor of considerable importance. The standard of surgery depends on the experience of the surgeon, the facilities available for good surgery and the condition of the injured tissues.

It might be suggested that it is unfair to compare primary sutures performed by surgeons of all types with secondary sutures performed at a nerve injury center by men experienced in nerve repair. However, many of the primary sutures which have failed were performed by experienced surgeons. More over after one of the primary sutures under taken at this nerve center a case in which there were no complicating factors, the results were not good. Furthermore, the wound treatment in peace or war is not usually performed by senior surgeons and we think it likely that we have in this series a fairly representative selection of the work of

those surgeons who are normally faced with the problem of primary nerve suture. It must be noted that we have excluded from this series three examples of gross error at the time of primary nerve suture when a nerve was sutured to a divided tendon.

Nearly all the primary sutures were undertaken at hospitals in this country in which the facilities for such emergency work are adequate.

In our opinion the chief adverse factor in primary suture is the difficulty in recognizing how much of the nerve has been damaged on each side of the site of division, with the result that resection is often inadequate. On the other hand if the resection is satisfactory there is the risk of excessive tension at the site of suture, since extensive mobilization of the nerve is never performed in a fresh wound. After 3 or 4 weeks the intraneural connective tissue changes are sufficiently obvious to indicate the amount of nerve to be resected, and there is the additional benefit of thickened nerve sheath which facilitates suture and makes the suture line more stable; the epineural stitches are less likely to pull through such a sheath than they would through that of a freshly divided nerve.

One further objection to the selection of cases in this series might be that only those primary sutures which were not progressing favorably would be sent to a nerve injury center. Many good results would thereby be missed. There are two answers to this objection first by arrangement with the medical departments of the three services, all cases of peripheral nerve injury are referred to appropriate centers. Second it is seldom possible to be sure within 6 months of the

date of suture whether the final result is likely to be good or not. We have ourselves found this difficulty even after sutures at the level of the wrist. Thirty six out of the total of 49 patients were referred to us earlier than 6 months after injury (Fig. 17) and it cannot, therefore, be accepted that we have had an undue proportion of those in whom the result was known to be poor.

CONCLUSION

The results set out in this paper raise important questions of policy in the primary treatment of divided nerves. In the usual civil or industrial laceration where one can expect wound healing within a few weeks primary suture may give a good result, but one can be more certain of a high grade of recovery after an early secondary suture. However there is nothing to be lost and indeed a great deal to be gained by approximating the ends of the divided nerve to prevent retraction. When secondary suture is performed in a few weeks the length of nerve to be resected will probably be short the suture can be performed with precision and without tension and the prospects of recovery will be good. If deliberate primary suture has been performed the patient should be watched carefully for early signs of recovery and if they are lacking or progress appears to be unduly slow re-exploration should be undertaken without delay and further resection and resuture considered.

In war wounds the local damage to the nerve ends is likely to be more extensive and the chances of performing an adequate excision of damaged nerve trunk and accurate epineural suture at the primary operation are not so good. An early secondary suture is more reliable. Here again primary approximation of the nerve ends is important and with adequate wound surgery and the latest adjuncts to prevent sepsis and encourage wound healing the secondary operation should be possible within a few weeks or at most a few months. Although we have arbitrarily chosen a limit of 6 months for

early secondary sutures we are convinced that, even within this period, the earlier the suture is undertaken the better.

We can sum up our views as follows. Formal nerve suture should be undertaken at the earliest moment when it is possible to recognize the extent of damage to the nerve excise the injured segment and bring together the mobilized nerve ends without the prospect of undue postoperative tension.

SUMMARY

1 The results of 55 primary nerve sutures are presented and compared with results of a series of early secondary sutures.

2 There was a higher proportion of poor recoveries and a lower proportion of good recoveries after primary suture.

3 Sepsis was not the chief adverse factor involved.

4 The histological examination of the site of primary suture in 16 cases indicated that the chief faults were poor technique inadequate resection of the damaged nerve ends and excessive postoperative tension.

5 There is a better prospect of a good recovery after an early secondary suture than after primary suture.

6 Primary approximation of the divided nerve stumps is always advisable.

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A CLINICAL AND PATHOLOGIC STUDY OF THE KIDNEY IN PATIENTS WITH THERMAL BURNS

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IMPAIRMENT of kidney function as evidenced by persistent oliguria and elevation of the nonprotein nitrogen in the blood is a frequent early complication in the course of patients with severe thermal burns. (9,34) This syndrome is often accompanied by albuminuria and urinary casts (34). A few descriptions of the morphology of the kidneys in patients dying with burns have been published (9,10,23,34) the most consistent findings being the following—on microscopic examination the glomeruli are usually normal while the tubules show varying degrees of necrosis affecting principally the convoluted part. Pigmented casts have also been observed in the tubules. These have been considered to be hemoglobin casts although direct proof of this is lacking. Some support to this conception of the nature of the casts is lent by the occurrence of hemoglobin in the blood and urine of severely burned patients (23). In none of these reports however has there been an attempt made to correlate the clinical and pathologic findings. Such a study based on 47 patients with fatal thermal burns admitted to the Boston City Hospital during the period from November 1942 to July 1944 is presented here. Additional data on patients who were admitted and survived during the same period will be presented elsewhere.

METHODS

In the following study the area of burn was estimated by the method of Lund and Brown

der. The depth of burn is described according to the new method of Converse and Robb-Smith. They classify burns by name instead of number using the terms epidermal for so called first degree burns, dermal and deep dermal for second degree and deep for third degree. The area of epidermal burn was disregarded. The extent of the deep burn cannot be determined with accuracy in patients who survive for only a few days. For this reason the extent of deep burn in such patients can only be estimated. Associated respiratory tract injury was graded from 0 to 4, depending upon the extent of injury to the respiratory tract found at autopsy.

The local treatment of the burns varied. During 1942 triple dye and tannic acid-silver nitrate were most frequently used, while during 1943 and 1944 the most frequent methods were pressure dressings or casts, dry or with a bland ointment. Morphine was usually given two or three times in the first 36 hours, in doses of $\frac{1}{4}$ grain for adults and correspondingly smaller doses for children. In a small number of patients phenobarbital or pentobarbital were used for sedation. Most patients with burns involving more than 10 per cent of the body surface received intravenous infusions of citrated plasma or serum. The plasma contained dextrose in amounts varying from 10 to 17 grams for each unit of 250 cubic centimeters. Some contained merthiolate in a final concentration of 1:10,000 as a preservative. Many patients received transfusions of type specific citrated whole blood. A small number of patients received intravenous injections of a 25 per cent solution of human albumin. This also contained an organic mercurial 1:10,000 as a preservative. Sodium lactate was given intravenously to some patients in the form of a molar aqueous solution and others were given sodium bicarbonate by the oral and intravenous routes.

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Fig. 1. Case 16. Note pale swollen cortex and contrastingly dark medulla with dark lines converging toward papillae. These lines in fresh tissue are black and histologically prove to be tubules containing blood pigment casts.

Intravenous glucose and isotonic salt solutions were also given to most of the patients.

In the evaluation of kidney function the following signs were considered to constitute evidence of lasting impairment—persistent azotemia with a level of nonprotein nitrogen exceeding 40 milligrams per 100 cubic centimeters of blood and oliguria or anuria persisting beyond the period of shock. Periods of transient azotemia and oliguria occurring only during the period of shock or terminally or associated primarily with heart failure were not considered evidence of lasting renal dysfunction due to the burn. The plasma nonprotein nitrogen, total protein, and albumin determinations were carried out by the routine methods as given by Peters and Van Slyke. In patients receiving sulfonamides (chiefly sulfadiazine) the blood levels of the drug were determined at regular intervals. Hemoglobinuria was detected by examination of the supernatant plasma in the hematocrit tube. The icterus index was estimated by the method of Murphy.

Hemoglobinuria was detected by the red or dark red appearance of the urine in the absence of gross hematuria. In most cases the diagnosis was confirmed by a guaiac or benzidine test. In some cases the qualitative

reaction for detection of hemosiderin with ammonium sulfide was carried out. The urine was usually tested for acidity or alkalinity by litmus paper but occasionally more accurate estimation was made with nitrazine paper.

Shock was recognized by the usual clinical criteria of fall in blood pressure, rapid thready pulse, clammy extremities. An attempt was made to grade the severity of shock according to intensity and duration. The following criteria and qualifications were used for grading: 0 patients who were never in shock; 1 patients who were once in shock for a period not exceeding 1 hour; 2 patients who were in shock from 1 to 4 hours; 3 patients who were in shock for longer than 4 hours or were in shock on more than one occasion. This last group includes also all patients who died in shock.

Morphologic examination of the kidney was done on sections fixed with Zenker's fluid and formalin and stained with phloxine, methylene blue, Lee-Brown modification of Mallory's aniline blue stain, sudan IV for fat, and a modified van Gieson stain for hemoglobin described by Dunn and Thompson. With this last method hemoglobin casts in the kidney stain varying shades of green. In our

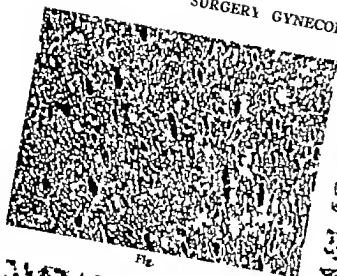


Fig. 3



Fig. 3



Fig. 4



Fig. 5



Fig. 6



Fig. 7

Fig. 3. Case 4. Three casts are shown of medulla showing granular character of pericles, containing the bottom cast and the large elongated crystal-like particles in the more centrally located cast. A few desquamated epithelial cells are present in the upper cast.

Fig. 4. Case 4. Coiled tubules show extensive degeneration and regenerating epithelium. The debris within the tubules stains red, the regenerating epithelial cells are flattened against the basement membrane and stain darkly. A mitotic figure is present in upper left quadrant of field.

(Legend: cast used on following 2 pages)

sections casts or portions of casts composed of desquamated tubule cell debris stained hematoxylin. Benzidine methods of demonstrating unsaturated globin, possibly because of long fixation in formalin.

A number of patients who were burned in the Cocoanut Grove fire are included in this report. In some of these cases it was impossible to secure all the desired data. However no patient in whom the essential clinical and laboratory data are lacking has been included.

OBSERVATIONS

Renal Morphological Changes

Twenty of the 47 patients showed definite morphologic changes in the kidney at autopsy. In 2 cases the renal lesion was acute pyelonephritis, entirely different from the lesions in the 18 other patients. In these latter patients the changes were all similar and consisted chiefly of the presence of tubular casts and degeneration and necrosis of the tubular epithelium (Figs. 1 to 7).

1 *Tubular casts* Tubular casts were found in all 18 cases and were made up of (1) pigment, and (2) desquamated epithelial cells. A maximum of 50 per low power field were found (Fig. 2). Casts composed largely or exclusively of pigment were most numerous. Casts composed entirely of epithelial cells were rare. Morphologically the pigment casts had a fine or moderately coarsely granular structure (Fig. 3). Most often the granules were approximately the size of red blood cells, or smaller. Large elongated crystal like green or blue cast particles were

sometimes found. The color with phloxine methylene blue stain varied from red to orange, brown green and blue. The blue color was most frequent although all the other colors usually could be seen in a single section. A positive staining reaction for hemoglobin in the casts was observed in all 17 cases in which this procedure was carried out. These casts were observed exclusively in the ascending and descending portions of the loops of Henle and in the collecting tubules. The greatest number was found in the medulla (Fig. 2) although some could also be seen in the cortex. Identification of the tubule involved was impossible in some instances because of presence of degenerated epithelium adjacent to a cast. The epithelial casts were made up of necrotic tubular epithelial cells, although pigment particles were usually present also (Fig. 6). These casts usually were acidophilic with phloxine methylene blue stain. When stained by the method of Dunn and Thompson for hemoglobin the cell debris stained red and the particles of pigment when present green. The staining reaction and the very fine granularity of the cell debris were similar to that of the cytoplasm of easily identifiable intact degenerated epithelial cells. In an occasional cast infiltrating monocytes and polymorphonuclear leucocytes were seen. Fibrin deposits in tubules were small and rare.

2 *Degeneration and necrosis of renal tubules* This change was found in two sites, i.e. in convoluted tubules and about casts lying within distal portions of the tubules. The degeneration and necrosis in these two sites seem to be distinctly different.

Necrosis and degeneration of convoluted tubules was found in 7 of the 18 patients. The tubules were swollen pale and granular. In some instances the cytoplasm was vacuolated in others the cells were partially or completely disintegrated so that individual cells could not be defined and the lumens of the tubules were filled with disintegrated cells (Figs. 4-5-7). The nuclei were often pyknotic or absent. There was no correlation between the number of pigment casts and the extent of tubular necrosis. In each instance the kidneys described as having tubule necrosis or degeneration also showed indirect evidence of

Fig. 4. Case 4. A large mitotic figure in a regenerating convoluted tubule is shown in the central part of the field. The tubule at the right of the field shows almost complete loss of epithelium with amorphous debris filling the lumen.

Fig. 5. Case 18. Casts here are composed of desquamated cell debris and blood pigment granules. The cell debris components are the large, rounded, dark bodies (red in phloxine-methylene blue sections and in sections stained for hemoglobin). Blood pigment particles are smaller and less dark (brown green or blue in phloxine-methylene blue sections and giving a positive stain for hemoglobin). Note also local damage to tubules containing the casts.

Fig. 6. Case 9. Convoluted tubules showing degeneration and regeneration. In the center is a tubule with flat, recently regenerated epithelium. There is a mitotic figure at the extreme left of this tubule.

the antemortem nature of the changes by the presence of one or more of the following—regenerating epithelium, mitotic figures indicative of tubular regeneration and casts in the distal portion of the tubules composed of desquamated necrotic epithelial cells.

Tubular necrosis adjacent to casts were seen in 12 cases. The necrosis was limited to the cells surrounding casts. The cells were not swollen, pale or granular but were deeply eosinophilic. Nuclei were pyknotic or absent. In many instances the cells had become separated from the basement membrane and incorporated into the cast. About some casts no cells were seen and only the basement membrane of the tubules remained.

3 Regeneration of epithelium Regenerating epithelium was found in 7 cases. Its presence is indicative of repair of tubular necrosis. In some cases necrosis was demonstrable along with regeneration. In others, actual necrotic cells were no longer present.

Regenerating epithelial cells in the presence of necrotic cells were flat and basophilic lying against the basement membrane. In contrast, the eosinophilic, pale, granular necrotic cells often overlaid the regenerating cells (Figs. 4, 5). Mitotic figures were usually not numerous (Figs. 4, 5, 7). Cells with mitotic figures were usually large cells which protruded prominently into the lumen (Fig. 5). In tubules which were composed entirely of recently regenerated epithelium and from which the necrotic cells had disappeared, the lumen appeared large because of the flat lining epithelium (Fig. 7). Mitotic figures in these less actively regenerating tubules were fewer.

4 Gross pathological changes In contrast to the microscopic examination gross examination of the kidney revealed abnormalities in only 5 cases. In 3 cases the medulla had a dark red appearance and presented prominent black, brown, or purple-red streaks converging toward the papillae. The dark streaks in the pyramids correspond to the tubules filled with pigment casts. In 4 cases the cortex and the zone of the medulla included between the pyramids were definitely paler and more swollen than normal (Fig. 1). This appearance was considered due to the tubular degeneration. In 2 cases, the kidney

weights were significantly higher than normal whereas in all other cases the weight of the kidneys approximated the upper limit of the normal value or was only slightly increased. In 2 cases unidentified orange crystals were seen. Small areas of hemorrhage were seen in the mucosa of the pelvis in 4 cases. In 1 case a similar area of hemorrhage was observed beneath the mucosa of the ureter.

5 Classification of the patients according to the morphological changes For the purpose of analysis, the 47 patients are divided into two groups on the basis of the autopsy findings. Group 1 comprises those in whom definite morphologic abnormalities were found in the kidneys while Group 2 is made up of those in whom no definite anatomical changes were found in the kidneys. Group 1 is composed of 20 patients and group 2 of 27 patients. Three patients in group 2 who died within 6 hours after injury are considered separately since they differed markedly from the others in extent of deep burn, severity of shock, clinical course, and early death. Two patients in group 1 are also considered apart since the morphologic abnormalities observed in their kidneys were probably not directly related to the burn. In both of these patients the renal lesion was that of acute pyelonephritis and was different from the renal lesions observed in the other 28 cases in group 1.

In the following discussion, the patients in group 1 (with the exception of 2 patients) will be contrasted with the 24 patients in group 2 who survived longer than 6 hours following injury.

Renal Function

A striking contrast between the two groups appears when the renal function is considered. The elevation of nonprotein nitrogen was higher in group 1 than in group 2. Two group 1 cases had nonprotein nitrogen levels above 150 milligrams per 100 cubic centimeters and 7 others had levels above 80. In group 2 only 3 patients had levels as high as 80. The high elevation was more constant in group 1 than in group 2. Sixteen out of 17 of the former cases on which data are available had an elevated level commencing shortly after injury and persisting to death. Among the

group 2 cases, 15 of the 24 patients had an elevation at any time and 3 of these elevations occurred late in the course. In most of the remaining group 2 patients the elevation decreased to normal before death after an early elevation.

Oliguria of a persistent nature was present in 7 of 11 patients of group 1 surviving longer than 2 days. All patients in this group who died within 48 hours also had oliguria. In contrast oliguria was observed in 6 patients of group 2 and in 5 of them it was limited to the period of shock. In the sixth patient the oliguria was associated with cardiac failure.

Examination of the incomplete data on specific gravity of the urine does not show a clear correlation between the amount of retention of nonprotein nitrogen in the blood and the ability of the kidney to concentrate or dilute urine.

A comparison of the amounts of nitrogen excreted in the urine by the patients of the two groups is difficult because determinations of daily urinary nitrogen were not carried out in all cases and because of the differences in time of survival after injury between the two groups of patients. However the available data suggest that there was, on the average, a higher output of urinary nitrogen in patients of group 2 than in patients of group 1. This is rendered more significant by the fact described above that the blood nonprotein nitrogen level was more elevated in group 1 than in group 2. Data on urinary nitrogen as compared to the blood levels of nonprotein nitrogen in 2 of our cases illustrate this point.

Urine reaction: Eleven of 13 patients in group 1 on whom the initial reaction of the urine was tested had acid urine. In the 2 other cases, it was neutral. Two had alkaline urines subsequently in the first 24 hours. In group 2 the initial reaction of the urine was tested in 13 patients and found acid in all except 3. It was alkaline in 2 cases and neutral in the third. Subsequent samples of urine were acid in most cases.

Other findings in the urine. Granular and hyaline casts were found in the urine of 9 patients in group 1 and 4 in group 2. Protein was present in significant amounts in the

urine of 15 patients in group 1 and in 12 patients in group 2. Significant numbers of red and white cells were found occasionally in the urine of 13 patients and repeatedly in the urine of 5 patients in group 1. Thirteen patients in group 2 had white and red blood cells in the urine on one or more occasions. Peripheral edema was observed in 8 cases in group 1 and in 4 cases in group 2.

Age Sex Surface Treatment and Fever

There were no essential differences between the patients in both groups in regard to age sex and surface treatment. The ages varied from 1 year to 78 years. The sexes were equally divided. Dry gauze or petroleum jelly pressure dressings were the most frequent form of surface dressing. Four patients in each group were treated with triple dye. Four patients in group 1 and 2 in group 2 were treated by the application of tannic acid and silver nitrate. All patients had fever at some time during the course of their illness. There was no significant difference between the two groups as far as number of patients with fever and intensity of the pyrexia are concerned.

Other Observations

Hypoproteinemia Eleven patients in group 1 and 17 in group 2 had hypoproteinemia at some time during their hospital course. In almost all the fraction of the plasma protein most lowered was the albumin fraction.

Surface area burned. In general the patients in group 1 had more extensive burns than did the patients in group 2. In group 1 10 patients had 50 per cent or more of the body surface burned while only 3 patients in group 2 had burns of this extent. This marked contrast is also apparent when the extent of deep burn is compared in both groups. Thus, in 12 patients in group 1 the extent of deep burn was 35 per cent or greater of the body surface while in only 4 patients of group 2 was the deep burn of this extent. One patient in group 1 had a conspicuously small burn.

Respiratory damage. Many patients in each group suffered respiratory damage from inhalation of hot air and smoke. Very severe grade 4 respiratory damage was sustained by 4 patients in each group.

Hemoglobinemia and hemoglobinuria Hemoglobinemia was observed in all cases of group 1 in whom the determination was done and lasted from 1 to 4 days after the burn. It was observed to a lesser degree in 14 patients in group 2. Six patients in this group did not have hemoglobinemia. Twelve of the 16 patients in group 1 on whom data are available had hemoglobinuria while only 1 patient in group 2 had hemoglobinuria. Hemoglobin casts were seen in the urine of 3 patients in group 1 and in none in group 2.

Hemoconcentration During the first 24 hours hemoconcentration was observed in twelve patients in group 1 and in 16 in group 2.

Shock Sixteen patients in group 1 and 12 patients in group 2 had clinical shock at some time during the first 36 hours. However the severity and duration of shock was greater in group 1 than in group 2. Grade 3 shock was observed in 11 cases in group 1 and in only 3 cases in group 2. It should be pointed out, however, that 2 patients in group 1 had no shock and 1 had mild shock.

Plasma and serum The quantity of plasma and serum given was, on the average, higher in patients of group 1 than in patients of group 2; the average in group 1 being 2.9 liters, the average in group 2 1.8 liters in the first 48 hours. Most of the plasma was given in the first 24 hours.

Albumin In the form of a 25 per cent solution was given during the first 48 hours to 5 patients in group 1 and to 4 patients in group 2. It was given later to 3 group 1 patients and to 1 group 2 patient.

Mercury The plasma serum and albumin used early in the study contained an organic mercurial preservative and some of the patients received enough plasma in relation to their body weight in the first 24 hours to raise the question of mercury toxicity. However 7 patients in group 1 received fluids without mercury.

Physiological saline In variable quantities was given parenterally to most patients in both groups. The average amount given during the first 48 hours was 1.9 liters in group 1 and 1.5 liters in group 2.

Parenteral glucose solution 5 or 10 per cent was given to practically all patients in both

groups. The average amount given in the first 48 hours was 1.9 liters in each group.

Blood transfusions Eight patients in group 1 and 10 patients in group 2 received type specific blood transfusions during their course. There was no evidence of a hemolytic transfusion reaction in any patient. Furthermore, there were 10 patients in group 1 who did not receive blood.

Drug therapy Six patients in group 1 and 18 in group 2 received sulfadruugs. This was sulfadiazine in most cases, 3 patients receiving sulfathiazole. Drug levels in the blood were markedly elevated in 1 case and moderately elevated in 2 cases in group 1. They were moderately elevated in 4 cases in group 2.

Sulfadruug crystals in the urine were found repeatedly in 1 case and on 1 occasion in one other case in group 1. They were found repeatedly in 3 cases in group 2. In no instance was this accompanied by significant hematuria. There were 7 patients in group 1 who received neither blood transfusions nor sulfonamides, and there were 2 patients who received neither blood transfusions, sulfonamides nor mercury.

Sodium lactate or bicarbonate was given on entry to 12 patients of group 2 and to 14 patients in group 2.

Diuretics Aminophylline, 50 per cent glucose solution or both were given intravenously to a number of patients in each group. The glucose solution was given in 4 cases and aminophylline in 21 cases, 12 in group 1 and 9 in group 2. In most cases the aminophylline was given for bronchial spasm and not as a diuretic. There was no evidence that the hypertonic glucose solution or the aminophylline had any significant diuretic effect in these cases. Albumin was given for possible diuretic action to 3 group 1 patients. In 1 of these it seemed to have a definite diuretic action (see Case 4 report) while in the 2 others no effect was observed (see Case 2 report).

Complications and time of death. The most common complication encountered in the 2 groups of patients were of a pulmonary nature. Pneumonia, bronchopneumonia, and pulmonary congestion occurred in about one-half of the patients in each group. Other compli-

cations were atelectasis of the lung in 2 cases pyrogenic plasma reaction in 2 cases, the latter having received grossly contaminated plasma acute hemorrhagic cystitis in 5 cases cerebral edema in 3 cases, and central necrosis of the liver in 1 case

On the whole the patients in group 1 died earlier than did the patients in group 2 The cause of death was variable In many cases the injury to the respiratory tract was the chief cause of death In some death was due to the complications noted above (chiefly pneumonia) but in some cases it was impossible to state what the patient died of more specifically than extensive burns Two patients in group 1 died of shock due to burn In only 2 cases could kidney failure be considered the chief cause of death

Patients with acute pyelonephritis As was stated before, 2 patients in group 1 are considered separately since although the kidneys in these 2 patients were abnormal morphologically the anatomical lesion was quite different from that observed in the 18 other patients in group 1 The renal lesion in these 2 patients was that of acute pyelonephritis. Both were in shock and had hemoglobinemia on admission Patient 16 in addition had hemoglobinuria Patient 3 had been on constant bladder drainage from the time of admission to death.

Patients in group 2 who died within 6 hours after burn Three patients in group 2 are also considered separately since they differed so much clinically from the remaining patients in this group All 3 had extensive deep burns and respiratory tract injury They were all in profound shock and had marked hemoglobinemia One was completely anuric while the 2 others excreted a very small quantity of acid urine containing hemoglobin The non-protein nitrogen level in the blood was elevated on admission in 1 patient and normal in 2 patients. All 3 patients died within 6 hours after admission 2 (Cases 21, 23) of shock and 1 (Case 22) of asphyxiation None showed any renal changes at autopsy

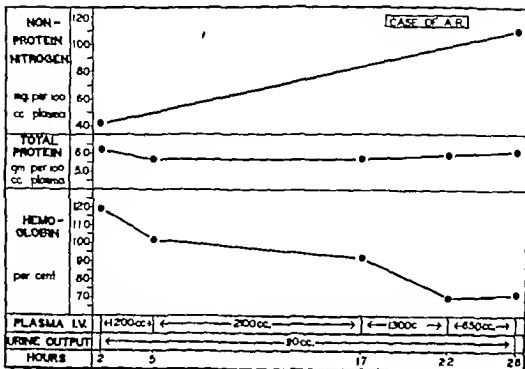
CASE REPORTS

CASE 20 Extensive deep burns hemoglobinuria shock oliguria azotemia and marked renal changes at

autopsy This 9 year old boy with a noncontributory past history was admitted shortly after receiving deep flame burns of almost his entire body Examination revealed a well developed and well nourished boy in moderate distress The total burned area was about 90 per cent Most of the areas appeared to be deep The skin was hard leathery and brown with very little external ooze. Areas were clean The chest was clear throughout The pulse was 100 of good quality blood pressure 110/70 and the respirations 20.

Under morphine sedation $\frac{1}{4}$ grain, petrolatum pressure dressings were applied to all areas except the abdomen which was treated with triple dye By the end of the dressing the patient had received 200 cubic centimeters of plasma containing 20 cubic centimeters of molar lactate He was definitely in shock at this time The pulse was very rapid and thready the feet hands and face (which were the only exposed areas) were cyanotic and cold Plasma was forced in by syringe, 450 cubic centimeters being given in 10 minutes. There was immediate improvement in the circulation He was catheterized at this time and a small amount of dark brown acid urine was obtained He was left on constant bladder drainage. He was given sodium bicarbonate one half gram by mouth During the next 12 hours the patient received about 2500 to 3000 cubic centimeters more of plasma and 20 cubic centimeters of molar sodium lactate He took only a small amount of water by mouth and vomited as soon as any fluid was taken His pulse varied from 100 to 140 The blood pressure could not be taken because the extremities were in dressings The temperature rose to 104 degrees rectally at 14 hours and exposed areas were sponged with cold alcohol He became stupor and the pulse was barely perceptible. Five hundred cubic centimeters of plasma and $\frac{1}{2}$ gram of sodium bicarbonate was given rapidly in 10 minutes by syringe with definite improvement in the quality of the pulse Shortly thereafter he began having generalized twitchings and clonic movements each convulsive episode lasting about 5 minutes. Lu minimal in 2 grain doses was given intramuscularly The temperature rose to 107 degrees and pulse to 150 and was weak. He remained comatose and died 36 hours after entry He had received a total of 4800 cubic centimeters of plasma intravenously His total output was 90 cubic centimeters of very dark brown urine

Laboratory data The hemoglobin total protein and nonprotein nitrogen data are given in Chart 1 and nonprotein nitrogen data are given in Chart 1 There was moderate hemoconcentration on entry which was corrected by the plasma infusions The plasma protein concentration remained within normal range The nonprotein nitrogen rose rapidly from a high normal value to over 100 milligrams. Hemoglobinemia was marked Analysis of the urine specimens revealed a dark brown acid urine of specific gravity 1.030 with no acetone, bile or sugar It continued to be dark brown or black. The amount of proteinuria increased progressively from



Chart

a slight trace to a very heavy trace. The sediment revealed granular casts and γ t. to red blood cells. The benadine and hemosiderin stains were positive.

Autopsy findings. B rns covered 90 per cent of the body surface and were chiefly deep. The lungs were congested and edematous with partial atelectasis of the lower lobes. The combined weight of the kidneys was 160 grams. The cut surface revealed a slightly redder than normal cortex and medulla with minute red streakings converging at the papillae. Microscopic examination revealed that the glomerular spaces contained dark blue granular precipitate. The same precipitate was found in most tubules. There was no modification of the basement membrane of the tufts and no cellular infiltration or endothelial or epithelial hyperplasia. The tubules contained numerous pigment casts. Fifty casts were counted in a single low power field (100X) in the medulla. The casts were found in the descending limbs of Henle's loop and collecting tubules. Most of the casts were composed of red granules. Some, however, were brown others blue. The particles ranged from fine granules to larger round masses. Most cast particles gave a positive stain (green) for hemoglobin. Mononuclear cells with eosinophilic cytoplasm and pyknotic nuclei were encountered occasionally within the casts. The cytoplasm of these cells stained red with hemoglobin stain. The convoluted tubular changes were marked and except for the absence of regenerating epithelium were identical with that seen in the kidneys of Case 12. There were areas where the nuclei were

completely missing and the cells were granular and had filled the tubular lumen with amorphous masses of cytoplasm. There did not appear to be any interstitial edema. There was no leukocytic infiltration. There was no congestion of interstitial vessels.

CASE 1. *Minimal surface burn was followed by respiratory tract injury, no shock, anemia and renal changes at autopsy.* This 43 year old woman received burns at the Coconut Grove fire. She had inhaled a considerable amount of hot smoke and had lost consciousness. The past history was not obtained. Examination revealed a fairly well developed and well nourished woman. She was unconscious. She had marked stridor, dyspnea, and cyanosis. The only external burn was a small area on her nose. The pulse was rapid. During the first 24 hours she received 1000 cubic centimeters of plasma, 1500 cubic centimeters of saline and 1000 cubic centimeters of glucose in water. No data are available as to the urine output on the first day. On the second day 500 cubic centimeters of dark urine was passed and on the third day 300 cubic centimeters. At the end of 9 hours because of increasing respiratory distress, a tracheotomy was performed. The respirations improved markedly for a brief period. On the third day sulfadiazine was started. The respirations continued to be labored with coarse rales throughout both lung fields. The patient died on the fourth day following a sudden increase in respiratory distress.

Laboratory data. On the second day the hemoglobin was 90 per cent and the nonprotein nitrogen

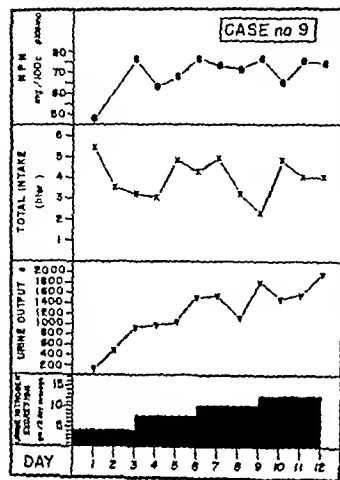


Chart 2

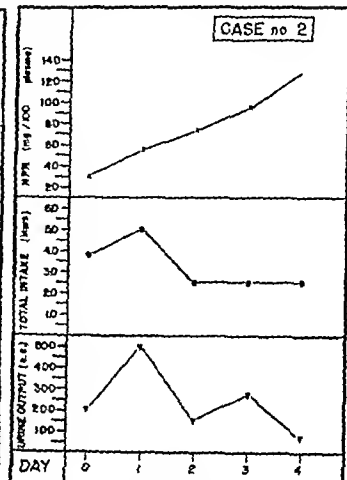


Chart 3

was 94 milligrams per 100 cubic centimeters of plasma. The urine was dark in color with a slight trace of albumin and no sugar or acetone. There were 0-5 white blood cells and no casts.

Autopsy findings. The following were noted: a burn dermal, of nose acute laryngo tracheobronchitis (inhalation) congestion of the spleen and liver, bronchopneumonia and edema of the lungs. The kidneys together weighed 310 grams. The pale gray pink cut surface of the cortex was clearly demarcated from the deeper stained red-blue pyramids. Microscopic revealed glomerular capsular spaces contained a moderately heavy precipitate. The same precipitate was found also in all tubules. Otherwise there was no glomerular change. The capillaries contained blood, no thrombi were present. There was no modification of the basement membrane. There was no endothelial or epithelial cell hyperplasia or inflammatory cell infiltration. The tubules contained casts and showed some damage to the tubular epithelium. The casts were found in the tubules of the medulla and less often in tubules of the cortex. The epithelium was so modified in the portions containing casts that it was not always possible to identify the type of tubule. Collecting tubules and ascending limbs of Henle's loop were recognized in a few instances. The casts were for the most part composed of densely packed fine basophilic granules. There was a brown to red color to some casts. Part of some casts were pale blue and homogeneously smooth. An occasional cast was composed of larger bright red globular particles. With hemoglobin stains there were many casts of green particles and others of red. Recognizable desquamated cells presented red cytoplasm and pyknotic nuclei. It should be mentioned that here, as in other cases the nonpigment casts stained red and were cell debris in origin. Tubular necrosis was slight and seen most prominently in those portions containing casts. In places only the basement membrane remained elsewhere the epithelium was reduced to very flat cells. The tubular cells surrounding casts were flattened the cytoplasm deeply eosinophilic and the nuclei pyknotic others had fallen away from the basement membrane seeming to become part of the cast. The convoluted tubules gave the impression of being dilated, there being a considerably greater sized lumen than is usual. The cells were low and granular, and many cells contained no nuclei. Regenerating epithelium growing beneath degenerated cells was seen only rarely. A very rare mitotic figure was found. There was no cellular infiltration of interstitial tissue and no scars. Capsules, arterioles and pelves were not remarkable.

CASE 9. Extensive deep burn shock hemoglobinuria azotemia transient oliguria impaired urinary

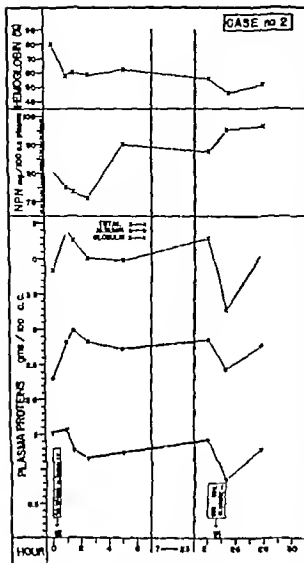


Chart 4.

nitrogen excretion and renal changes at autopsy A 29 year old woman with a noncontributory past history received burns over 45 per cent of the body surface, chiefly deep and respiratory tract injury at the Coconut Grove fire. Initial surface treatment was triple dye following soap and water cleansing. Pulse on entry was weak and rapid. In the first 24 hours she received 11 units of plasma, 3 liters of saline and 1½ liters of glucose in water. She took 800 cubic centimeters of water by mouth. Her circulation improved over a period of hours and there were no further episodes of peripheral collapse. The urine output was 200 cubic centimeters in the first day and thereafter over a liter daily. Sulfadiazine was begun on the third day. The free drug level rose to 14 milligrams per 100 cubic centimeters of blood and the total drug level to 18 milligrams per

100 cubic centimeters of blood on the fifth day. Thereafter, the sulfadiazine was given intermittently with levels being obtained as given below under laboratory data. On the seventh day the temperature which had been 99 to 100 degrees rose remaining at about 104 degrees thereafter. She became markedly dyspneic and there were diffuse rales and crepitations rales throughout the entire chest. Pulmonary signs and symptoms increased and the patient expired on the twelfth day.

Laboratory data (see Chart 4) The patient had moderate hemoconcentration on the first day. She developed a marked anemia by the fourth day the hemoglobin remaining at about 55 per cent despite daily transfusions. The nonprotein nitrogen was 48 milligrams per 100 cubic centimeters of plasma on the first day 75 on the third day at about which level it remained thereafter. Sulfadiazine level on the fourth and fifth days was about 14 milligrams per 100 cubic centimeters of blood "free" and 18 milligrams per 100 cubic centimeters of blood "total." Thereafter the drug levels ranged from 3 to 3 milligrams "free" and 4 to 9 milligrams "total." The plasma total protein concentration was 5.9 grams per 100 cubic centimeters of plasma on the first day with a normal albumin/globulin ratio. Thereafter the total proteins ranged from 4.2 to 5.1 the normal albumin/globulin ratio continuing normal. The urine nitrogen excretion rose from 4 grams daily during the first 3 days to 12 grams daily from the ninth to twelfth day. Urine at the 16th hour dark brown hemoglobin 80 milligrams per 100 cubic centimeters pH 5.2 specific gravity 1010 albumin slight, trace hemoglobin casts hemosiderin, 2 plus. Thereafter the specific gravity ranged from 1013 to 1017 and the sediment showed an occasional red and white blood cell.

Autopsy findings The following were noted: burns covered 45 per cent of the body surface, chiefly deep acute laryngotracheobronchitis (inhalation) bronchopneumonia. The kidneys together weighed 310 grams. The cortex was pale and somewhat swollen. Microscopic showed the glomeruli were not remarkable save for vacuolated pink precipitates within the capsular space. The tubules contained casts of the two general varieties and presented evidence of tubular degeneration. The pigment casts were composed of granules varying from brown to red with an occasional smooth, blue homogeneous irregular mass. The other casts were composed of cellular debris which was eosinophilic and granular. Faint outlines of cells with nuclei were present in these casts. There were less casts of this type than there were pigment casts. Casts were not numerous. Usually a maximum of three casts per low power field (40X) could be seen. Casts were found in the collecting tubules and loops of Henle. Desquamated degenerated cells were present within the lumen of the tubules but regenerated epithelium was the predominant feature indicating previous tubule damage. Identification of the tubules involved in this process was often impossible.

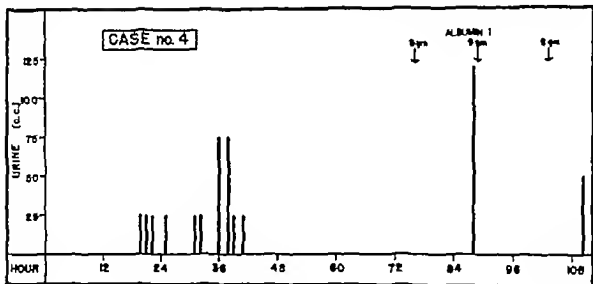


Chart 5

It appeared that the convoluted tubules and possibly ascending limbs of Henle's loop were affected. The regenerated epithelium was not as high as was the older epithelium and took a distinctly more basophilic stain. Mitotic figures could be seen occasionally, indicating that the process was still active. The interstitial tissue was very edematous. Tubules were widely separated by pale loose stroma and between glomerular capsules and tubules there were widened clear areas. In a few areas newly formed fibroblastic tissue was present in the loose edematous stroma. In more or less discrete patches there was a moderate infiltration with plasma cells and a lesser number of lymphocytes. Only a rare polymorphonuclear leucocyte was found. No tubules were found containing polymorphonuclear leucocytes. It is not possible to say that the interstitial reaction bore any anatomical relationship to degenerated tubules or tubules with casts. Several large veins contained thrombi partially filling the lumen. These thrombi were composed of fibrin, enmeshed leucocytes, red blood cells and a red granular substance of undetermined nature. In the largest veins fibroblasts were invading the thrombi from points of attachment. The surrounding interstitial tissue contained plasma cells and newly formed fibroblasts.

CASE 2 Extensive deep burns shock hemoglobinuria azotemia oliguria edema and marked renal changes at autopsy. No diuretic effect from 50 per cent glucose or 25 per cent albumin intravenously. This 40 year old white female with a noncontributory past history received flame burns about 6 hours before entry as a result of an oil stove explosion. She felt fairly well at home and entered because of persistent pain. Examination revealed a fairly well developed and nourished woman with mixed dermal and deep burns of 30 per cent of her body surface. The blood pressure was 70/40 the pulse rapid and thready. Morphine $\frac{1}{4}$ grain was given subcutaneously and plasma started intravenously and within

the next 2 hours 1000 cubic centimeters of plasma and 800 cubic centimeters of 5 per cent glucose in saline were given intravenously. Her blood pressure rose rapidly to 120/80 and her pulse fell to 94 and was of good quality. The burns were then washed and silver nitrate and tannic acid were applied. In the next 8 hours her blood pressure gradually fell and the pulse rose to 140 and was of poor quality. The patient was given 1200 cubic centimeters of plasma in 2 hours with a rise in blood pressure and a fall in the pulse resulting and for the rest of the day her pulse remained about 100 and was of good quality. The blood pressure rose steadily reaching a level of 100/110 about 30 hours after entry but in the next 8 hours it had dropped to 130/90. There were no further episodes of hypotension or hypertension. The output was 200 cubic centimeters in the first 24 hours. Her hemoglobin fell from a level of 96 per cent on entry to 60 per cent in 48 hours. One thousand cubic centimeters of blood was given in the next 2 days but the hemoglobin remained about 60 per cent. Small petechiae were evident over the abdomen at 36 hours. The platelet count at this time was 18,000. The petechiae gradually increased until the entire abdomen and chest were covered. In the next 36 hours generalized edema became evident. This edema increased during the next day and then gradually disappeared with no evident diuresis or evidence of fluid accumulation in either the thorax or abdomen. The patient had been given aminophyllin at 30 hours and again at 40 hours with no apparent diuresis being obtained. The urine output remained low throughout the course and the plasma nonprotein nitrogen rose from 30 milligrams per 100 cubic centimeters plasma on entry to 130 on the fourth day (see Chart 5). Concentrated albumin and 50 per cent glucose were given on the second day and third day without producing any diuresis. From examination of Chart 4 it may be seen that 200 cubic centimeters of 25 per cent albumin intravenously produced a somewhat greater apparent increase in

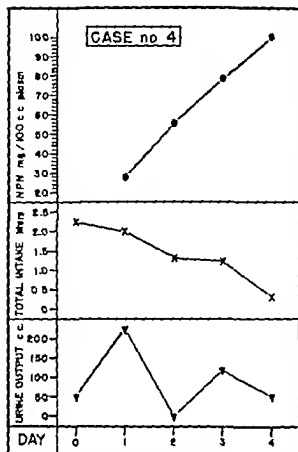


Chart 6

blood volume as judged by the serial hemoglobin determinations, than 500 cubic centimeters of 50 per cent glucose. In the former instance the plasma protein concentration rose from 3.8 to 4.4, the rise being due to an increase in the albumin fraction, while in the latter case plasma protein fell from 4.8 to 3.8. The temperature had risen to 103 degrees on the second day at which level it remained. The pulse and respirations rose gradually beginning on the fourth day and the patient became irritable and stuporous and expired on the fifth day.

Autopsy findings: Burns involved 35 per cent of the body surface chiefly deep. Petchial hemo-
 rhages of the skin, testicular tract myocardium, renal pelvis and ureter were noted. Patient had rheumatic heart disease, inactive minimal bilateral hydrothorax 750 cubic centimeters pulmonary edema, peripheral edema (feet legs genitalia). The combined weight of the kidneys was 300 grams. On the cut surface and in the pelvis were found many minute yellow crystals which could be scraped away easily. There were several small cysts (1 mm. in diameter) in each kidney. The pelvis showed marked submucosal hemorrhage. Along the ureters there were many petchiae. Cortex and medulla were well demarcated. Microscopic examination

revealed that the glomerular capsular space contained a small amount of fine pink granular precipitate. The tufts showed no modification of the basement membrane, no cellular proliferation of infiltration, and the capillaries showed no congestion or thrombosis. The tubules contained moderate numbers of casts. These are most numerous in the medullary regions. A maximum of 20 per low power field were counted. The casts are composed of aggregates of red to blue fine granules mingled with which were small amorphous blue masses and a few desquamated cells (phloxine methylene blue). The majority of tubules containing casts could not be identified but an occasional collecting tubule, ascending and rarely descending limbs of loop of Henle were identified as containing casts. Rarely an intact tubule was found packed with cells. These cells often appeared to be macrophages containing yellow to red granules. In other instances there were cells with the appearance of desquamated epithelium. In 2 instances a few polymorphonuclears surrounded the casts. In Zenker fixed tissue stained for hemoglobin, the larger particles were olive green in contrast to the red stain taken by desquamated cell debris. Degenerative changes of tubular epithelium was not definitely found except at the sites of casts. However mitotic figures and regenerated epithelium and the finding of desquamated epithelial cells in casts was indicative of tubular damage. Many tubules of the medulla contained numerous large yellow particles. The interstitial tissue contains small foci of lymphocytes. Arterioles were not remarkable.

CASE 4. Extensive burns shock azolemia anemia and renal changes at autopsy. Diuretic effect 8 pm 25 per cent albumin intravenously. A 2 year old male infant with noncontributory past history entered the hospital 3 1/2 hours after receiving mixed dermal and deep hot water burns of 50 per cent of his body surface. Examination revealed a well developed and nourished apathetic infant. His color was ashen, extremities were cold and clammy. The blood pressure was unobtainable pulse was rapid and thready, rate about 160 and the peripheral veins were collapsed. Petrolatum pressure dressings were applied with no preliminary cleansing. On entry plasma was begun intravenously 50 cubic centimeters being given in 5 minutes following which the patient's color improved the pulse became stronger the rate dropped to 13 and he began moving about. The rate of plasma administration was slowed down and in the next 40 minutes 250 cubic centimeters of plasma were given. The patient became pale less active and the pulse was weaker. After the rate of administration of plasma was speeded up, the color and the quality of the pulse improved. During the next 5 hours he received 400 cubic centimeters of plasma and 200 cubic centimeters of water by mouth, the quality of his pulse and his color remaining good. About 10 hours after injury there was a brief period of peripheral collapse which responded to an increased rate of plasma flow.

Shortly thereafter the patient voided for the first time 30 cubic centimeters of clear light yellow urine. He was given 200 cubic centimeters of 5 per cent glucose in water intravenously in the next 2 hours. Fifteen hours after the injury the patient had a generalized convulsion. The respirations became rapid and gasping. Cyanosis was marked the pulse very rapid and weak. The temperature was 104 degrees rectally. The patient quieted down in a few minutes but the pulse continued to be rapid and of poor quality. The neurological examination was negative. Plasma was begun and after 150 cubic centimeters had run in his color improved and the pulse became slow and stronger. During the next 2 days the patient had a number of similar convulsive seizures despite fairly heavy sedation with sodium luminal. On the third day he had a much more prolonged seizure which lasted about 1½ hours. The pulse and respirations became very weak and rapid. Coramine and adrenalin were given intravenously with transitory improvement in pulse and respirations. Adrenalin was repeated twice more in the next half hour with the blood pressure rising to 110/80 at which level it remained thereafter. During the first 48 hours the patient received 250 cubic centimeters of plasma, 250 cubic centimeters of 5 per cent glucose in water intravenously, 200 cubic centimeters of 5 per cent glucose in water by clysis and 1500 cubic centimeters of water by mouth. There was some abdominal distention at 15 hours and gastric lavage yielded 150 cubic centimeters of coffee ground material. In the next 30 hours there was an additional 250 cubic centimeters of similar material vomited. The urine output was low during this time the total being 175 cubic centimeters in seven 25 cubic centimeter amounts in the period of 12 to 38 hours. In the next 30 hours the patient received 500 cubic centimeters of blood intravenously, 850 cubic centimeters of water by mouth, 100 cubic centimeters of 5 per cent glucose in water and 250 cubic centimeters of sodium chloride and sodium lactate solution. Aminophyllin and mercupurin were also given intravenously. There was 200 cubic centimeters of vomitus and two liquid guaiac negative stools. The patient had started to become more noticeably edematous 48 hours after entry and this increased definitely in the next 5 hours. There had been no urine output for the last 32 hours. At this time 35 cubic centimeters of 25 per cent salt-free albumin was given intravenously (Chart 5). In the next few hours there was a definite reduction of edema and some beginning bladder dullness which gradually increased. Nine hours later the patient was catheterized and 200 cubic centimeters of urine was obtained. At this time 35 cubic centimeters additional albumin was given. The following morning 200 cubic centimeters of 5 per cent glucose in water was given by clysis and 150 cubic centimeters of water was taken by mouth. The edema increased again and following the administration of 35 cubic centimeters more albumin there was some decrease in the edema. Two hundred and fifty cubic centi-

imeters of whole blood and 3¼ cubic centimeters of aminophyllin were given intravenously and 50 cubic centimeters more urine were obtained. During this period the patient was having loose tarry stools. On the fifth day he became comatose and the neck was somewhat stiff. Neurological examination was otherwise negative. Lumbar puncture revealed clear fluid pressure 300. The patient remained comatose and about 4½ days after entry the respirations gradually increased the pulse became more rapid and weak, and the blood pressure was unobtainable. The respirations became suddenly markedly labored and the respirations and pulse stopped in a period of a few minutes. His non-protein nitrogen which had been normal on the first day rose to a level of 100 milligrams per 100 cubic centimeters of plasma shortly before death (Chart 6).

Autopsy findings: The following were noted: Burns 35 per cent of the body surface mixed dermal and deep acute esophagitis (traumatic—laryngeal Levine tube) pulmonary edema pleural effusion and abdominal ascites (slight). The combined weight of the kidneys was 70 grams. The cut surface seemed swollen and appeared to bulge slightly. The pyramids were darker than usual. Microscopic examination revealed the glomerular capillaries congested the capsular space small and contained pink granular precipitate. There was no modification of the basement membrane or Bowman's capsule. The tubules contained numerous casts and showed extensive degeneration with marked regeneration of the epithelium. A maximum of 48 casts was counted in a single low power field (100X). The medullary region contained the greatest number of casts. The casts were of two main types: i.e. pigment casts and casts composed of desquamated tubule epithelial debris. The former were most commonly composed of moderately coarse granules of blue or dark green color. The individual granules often were of ovoid or round form. Less commonly the particles assumed larger rod like green forms. In some casts there were desquamated cellular elements. Pigment casts were found for the most part in collecting tubules or in the ascending portions of the loops of Henle. Most of the casts give a positive staining reaction for hemoglobin. The casts formed of desquamated necrotic cells were found in the cortex in convoluted tubules and in tubules that could not be identified because of extensive degeneration. These casts were composed of brilliantly eosinophilic finely granular material. No nuclear material could be seen. In some instances there were no remaining viable epithelial cells so that the cast was bounded only by the basement membrane of the tubules. In other instances flat basophilic regenerating epithelium was seen underlying the eosinophilic masses. Mitotic figures were numerous in the regenerating cells. Regenerated cells completely replaced degenerated cells in some instances. The tubules did not contain fat droplets of degeneration. There was no cellular infiltration or

fibrosis of the interstitial tissues and no scarring of Arterioles and renal pelvis were not remarkable

DISCUSSION

Observations on renal function and renal changes at autopsy in 47 patients have been described. The patients were separated for purposes of analysis into two groups on the basis of the morphological abnormalities of the kidneys. Group 1 included 20 patients (Nos. 1 to 20) in whom the kidneys at autopsy were abnormal. Group 2 included 27 patients whose kidneys were normal morphologically. Two patients (Cases 3 and 16) in group 1 were considered separately because the renal lesion found at autopsy was an acute pyelonephritis, entirely different from the renal lesion observed in all other patients of this group. In addition 3 patients in group 2 with extensive burns who died very early were considered separately. It is possible that in these cases there was not time enough for the appearance of morphological changes that might have been expected from the severity of burn in these patients. These 5 patients are excluded from the following discussion.

The anatomical abnormalities described here in the kidney of 18 patients of group 1 vary in degree of intensity from one patient to the other but are homogeneous in the whole group. Pigmented casts, epithelial casts, tubular necrosis and tubular regeneration, in cases surviving more than 2 days. The pigment casts were probably derived from blood pigments. This is indicated by the fact that they were indistinguishable from similar casts found in the kidneys of patients with hemolytic transfusion reactions, and is further confirmed by the presence of a positive staining reaction for hemoglobin in these casts. Furthermore there was a close correlation between the presence of hemoglobinuria during life and the presence of pigment casts at autopsy.

There was a close correlation between the clinical and laboratory findings of renal function and the pathologic observations on the kidneys. All patients in group 1 had evidence of persistent kidney dysfunction while only 1 patient in group 2 presented such evidence and in this patient it was secondary

to cardiac failure. In the few group 2 patients who had elevated levels of the blood non-protein nitrogen, the levels were on the whole much lower than in group 1 patients. In addition the two highest levels recorded in group 2 (Cases 33, 38) occurred late in contrast to the early high levels observed in group 1. There was also a contrast between the 2 groups of patients in respect to urine output. It is well known that during a period of shock of what ever cause there is a marked decrease in the output of urine (18). However in most patients in group 1 with oliguria, this output lasted the period of shock and persisted until death while in all but one group 2 patient the oliguria was limited to the period of shock and in this patient the oliguria was associated with cardiac failure. In those patients of group 1 in whom the oliguria was transient there was evidence of impaired ability to clear nonprotein nitrogen products in the face of a urine output of a liter or more daily.

A number of factors can readily be ruled out as responsible for the difference in renal changes in the two groups since these factors occurred with equal frequency in both groups. These are (1) age, (2) sex, (3) surface treatment, (4) fever (5) plasma protein concentration, (6) fluid intake. The intake of fluids was somewhat higher on the average in group 1 than in group 2. This is readily explained by the more extensive burns and higher frequency of shock in group 1. Since the shock in almost all the patients in group 1 was successfully treated it is probable that sufficient quantities of fluids were given so that their oliguria is not to be explained on the basis of insufficient fluid intake. The types and proportions of fluids given were the same in both groups. (7) Chemotherapy was not a determining factor since 12 patients in group 1 did not receive sulfadruugs. In no instance was hemolysis seen as a complication of drug therapy. (8) The organic mercurial preservative present in some of the plasma, serum and albumin was not responsible for the production of the renal syndrome since equal numbers of patients in both groups received mercury free fluids and mercury containing fluids. (9) Blood transfusion. The possibility that the renal lesion was produced by hemo-

lytic transfusion reactions can be ruled out since there were 8 patients in group 1 who did not receive blood at any time during their course, and in the remainder there was no evidence of a hemolytic reaction.

The 2 groups of patients differed mainly in respect to the following factors (10) extent of burn and especially extent of deep burn (11) occurrence severity and duration of shock and (12) presence of hemoglobinuria.

Extent of burn The chief complications of burns such as toxemia progressive anemia and nutritional disorders are directly related to the extent of burn and particularly the extent of deep burn. This holds true in regard to renal complications, since two-thirds of the patients with kidney dysfunction had deep burns of greater than 35 per cent body surface while only one-sixth of the patients without kidney dysfunction had burns of this severity. One patient (Case 1) in group 1 had a very small surface burn but had very extensive respiratory tract damage. There were 3 other patients in group 1 and 4 in group 2 who also had severe respiratory tract damage. The problem of respiratory tract injury as a complication of thermal burns has been discussed elsewhere by Finland, Davidson and Levenson.

Shock As would be expected from the fact that the patients in group 1 were the most severely burned the occurrence of shock in this group of patients was more common and more severe and prolonged than in the patients in group 2. This difference is important since shock *per se* is known to have a profound effect on kidney function. The occurrence of oliguria during shock is well recognized and is presumably due to a markedly decreased blood flow through the kidney (18). The blood flow through the kidney may be reduced to as low as 5 per cent of its normal value during shock at a time when the general blood flow is only reduced to 50 per cent (18). That the renal failure observed in shock associated with burns may be different from that seen in other types of shock is suggested by the experiments of Olson and associates on dogs. They showed that in burn shock restoration of the blood pressure by infusions of saline did not increase the output of urine

while such infusions did increase the urinary output in hemorrhagic and tourniquet shock. The effect of shock on renal function is related to the severity and duration of the shock. Disturbances in renal function are more severe and more protracted when the shock is profound and lasting. Irreversibility of the function and morphologic alterations of the kidneys following severe shock have been described by Van Slyke. He showed that severe reduction in the renal blood flow during circulatory failure for a period of hours following hemorrhage is often followed by markedly impaired kidney function and pathologic changes in the kidneys consisting chiefly in tubular necrosis and the presence of pigment casts in the tubules.

Hemolysis The third factor of apparent importance in the pathogenesis of the renal injury following burns is intravascular hemolysis, since renal injury has been observed in a number of other conditions in which intravascular hemolysis occurs (2,7,21,28,32). Intravascular hemolysis occurs in all severely burned patients and is apparently caused by a direct action of heat on the red cells of the blood circulating in the burned areas (23). Its occurrence and severity are directly related to the extent of deep burn and, as would be expected, hemoglobinemia was greater in the patients in group 1 than in group 2. Hemoglobinuria was seen in nearly all the group 1 patients and in only 1 patient in group 2.

Monke and Yule in dogs and Altschule in men have demonstrated that hemoglobin is excreted in the urine only when the levels of free hemoglobin in the plasma reach values of about 150 milligrams per 100 cubic centimeters of plasma. Below this concentration it is apparently completely reabsorbed from the glomerular filtrate by the renal tubules. In chronic hemoglobinemia in dogs the threshold is lower which has been explained by a supposed saturation of the tubules with pigment derived from red cells (32). When hemoglobinemia is associated with shock the conditions for the appearance of hemoglobinuria may be different. Absence of hemoglobinuria in the presence of a marked hemoglobinemia in such cases could be due to

the decreased glomerular filtration caused by the vascular hypotension and the decreased renal blood flow. Furthermore if anuria of whatever cause is present as was the case in one of our patients, and as has been reported by DeGowin it is obvious that no hemoglobinuria can occur even in the presence of marked hemoglobinemia.

If the renal damage is a direct toxic effect of the products of intravascular hemolysis it can be produced only if the products of red cell hemolysis reach the kidney tubules. This seems likely since in these cases hemoglobinuria and not merely hemoglobinemia is associated with renal lesions. On the other hand, it may be just a question of degree of hemoglobinemia, since hemoglobinemia was more marked in the patients with hemoglobinuria than in those without hemoglobinuria.

Renal injury sometimes of a severe nature is sometimes seen following hemolytic blood transfusion reactions. The renal syndrome of hemolytic transfusion reactions includes oliguria or anuria, azotemia and often uremia. Morphologically the kidney changes such as pigmented casts in the tubules and tubular necrosis are strikingly similar to those seen in patients with severe burns. Here also as in the kidneys of burn patients, there is no apparent correlation between the number of casts and the extent of tubular necrosis (7). Other types of intravascular hemolysis have also been shown to affect the kidneys in a similar fashion. Renal failure has been described in cases of paroxysmal nocturnal hemoglobinuria (21), hemoglobinuria due to quinine poisoning (28), black water fever (31), acute hemolytic anemia due to sulfonamides (12) and hemoglobinuria of obscure origin (2).

The mechanical obstruction which may be caused by the pigment casts in the tubules seems quantitatively inadequate to explain the renal failure. It is possible that the tubular necrosis may play a part although the extent of tubular necrosis again does not seem sufficient to account for the failure. The sections of the kidney provide no information on the function of the glomeruli which may be impaired although their structure appears

normal. The identity of the substance or substances in hemolyzed blood which are responsible for the kidney injury and the mechanism of action are still debated. In dogs reduced hemoglobin and oxyhemoglobin do not appear to be toxic, while methemoglobin appears to be toxic in the presence of an acid urine. If the urine is alkaline methemoglobin is also nontoxic (4). It has been shown that when intravascular hemolysis occurs, part of the hemoglobin is oxidized to methemoglobin (27). The application of these observations to the cases studied here is obvious when one remembers that methemoglobin has been found in the blood and urine of burned patients (23, 24) and that the initial urines of most burned patients are acid. It is also possible that the products of hemolysis are particularly toxic to the kidneys of patients in shock. Under the conditions of relative ischemia and anoxia, the kidney may be more susceptible to injury. Yule and his associates have shown recently in experimental animals that renal injury by hemoglobin occurred only when the kidney had been damaged previously. Another possibility is that some other constituent of the red blood cells set free during hemolysis, for instance the stroma, is toxic since solutions of hemoglobin are much less toxic than is hemolyzed blood (33).

The problem of the toxicity of hemolyzed blood is intimately linked with the question whether alkalization of the urine is in any way preventative of renal damage. This question in relation to the kidney dysfunction in patients with burns cannot be solved on clinical grounds alone since practically all severely burned patients have an acid urine when they are admitted to the hospital and intravascular hemolysis has already existed for at least an hour before alkalization of the urine is attempted. No studies in animals comparable to those of Baker and Dodds on the effect of alkalization on the renal damage following hemolytic blood transfusion reaction have been made. The effect of alkalization of the urine after hemolysis has been present cannot be evaluated from the data reported here since despite the administration of alkali on entry the urines remained

acid during the first 12 hours in most patients Walker reported no benefit from early alkalization in his patients with burns

The renal syndrome of severe burns is similar to the renal syndrome associated with crush injuries. The urine in the latter syndrome, however, contains myoglobin rather than hemoglobin and the pigmented tubular casts have also been shown to contain myoglobin (5). It is believed that the myoglobin originates from the crushed muscles. Idiopathic paralytic myoglobinuria which is rarely encountered in man but is occasionally seen in horses is also characterized by myoglobinemia and myoglobinuria and a clinical and pathologic renal picture entirely similar to that found after crush injury. Shen and Ham and Taylor and associates (24) have looked for myoglobin in the blood and urine of some burned patients but in no case was any found. Kidney dysfunction and renal changes similar to those described here have also been reported following severe traumatic injuries (noncrush) with shock.

The azotemia observed in this series of patients deserves special comment since it may be due in part, to an increased production of nonprotein nitrogen in the presence of a failing kidney. The very rapid rise in nonprotein nitrogen values observed is best explained by a factor of increased production together with decreased excretion. This view is further supported by the fact that there is an increased breakdown of proteins in burns (25).

Partition studies of the nonprotein nitrogen products in the blood and urine of some of these patients with azotemia have revealed an increase in the residual nitrogen fraction (25,30). This has not been found in all patients with clinical and pathologic changes. Its significance is not known at present.

There is no evidence in the present series of cases that aminophyllin or hypertonic glucose solution intravenously led to any diuresis in the patients with impaired renal function. In 1 case following the administration of albumin intravenously there was an increase in urine output. In 2 other patients to whom albumin was given for a possible diuretic effect, there was no increase in urine output.

It would appear that a very important measure to be taken for preventing renal damage is the prompt and vigorous prophylaxis and treatment of shock. The efficacy of early alkalization has not been definitely evaluated. The injection of reducing agents to reduce the methemoglobin appears logical but has had no adequate clinical or experimental trial. Once renal dysfunction has appeared care must be taken in the administration of fluids particularly sodium-containing fluids, to avoid overloading the circulation. Aminophyllin and hypertonic glucose have not proved useful diuretic agents and the latter in the presence of hypoproteinemia may lead to dangerously low plasma protein concentration. Albumin should be tried, particularly if there is hypoalbuminemia and peripheral edema. A possible danger would be the production of pulmonary edema. The use of diathermy (19) x ray (29), decapsulation (1), sympathectomy (20) and spinal anesthesia (20) have not been evaluated.

It should be mentioned that most of the patients with renal dysfunction died of causes other than renal failure. However it is possible that if these complications can be avoided the patient would go on to death from renal failure. In such cases it would be useful if measures could be taken to tide the patient over until renal tissue has had an opportunity to regenerate and, possibly function to be restored. Extravascular (26) or peritoneal dialysis (22) might be useful if they can be carried out practically and successfully.

SUMMARY

1 Forty-seven patients with burns were studied in an attempt to establish a correlation between kidney function during life and morphologic kidney abnormalities at autopsy.

2 Twenty patients had abnormal kidneys at autopsy and except in 2 cases which showed pyelonephritis the renal lesions consisted of tubular necrosis and the presence of pigment and cellular casts in the tubules. The remaining 27 patients had no significant renal morphologic changes.

3 The pigment casts gave positive "hemoglobin stains" but no more specific identification was made.

SURGERY GYNECOLOGY AND OBSTETRICS

4. Clinically kidney dysfunction was manifested by persistent azotemia oliguria, decreased urinary nitrogen excretion, and rarely edema. Renal dysfunction was probably the cause of death in 2 patients.

5. A close correlation was found among renal dysfunction morphologic abnormalities of the kidneys and extent of deep burn severity of shock, and presence of hemoglobinuria.

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A NEW METHOD OF TREATMENT FOR SEVERE FRACTURES OF THE OS CALCIS

A Preliminary Report

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IN the past a fracture of the os calcis was a relatively rare injury confined very largely to window cleaners. Modern warfare however with the introduction of the torpedo land mine paratroop landings, and other features of warfare has increased not only its absolute incidence but also the relative frequency of the severe highly comminuted type. Despite the most energetic treatment the resultant disability remains a serious one. Patients are left with persistent pain stiffness inability to walk over rough ground or do ladder work or indeed any form of hard manual labor.

In those cases in which the subastragaloid joint has not been affected early movements

from the Fracture and Orthopaedic Departments of the Bristol Royal Hospital

and freedom from weightbearing for 6 weeks produce good results, and the patients are able to return to their preaccident occupations. But in others even when the fracture does not appear to be a serious one subastragaloid arthritis develops out of all proportion to the x ray findings so that the end result is much worse than would be expected the disability consisting as before, of pain and stiffness. Despite individual variations in tolerance to pain the findings in a large number of patients are remarkably consistent.

Several views of a fractured os calcis were taken and from these the upper surface of the os calcis has been reconstructed as shown in Figure 1. The disruption and distortion of the subastragaloid joint can be seen. Any form of treatment to correct and get fair alignment of this complex joint surface is obviously impossible. Consequently the patient develops a severe subastragaloid arthritis.

The lateral view which is illustrated in Figure 2 shows how the os calcis has been broken on the wedgeshaped lower border of the astragalus.

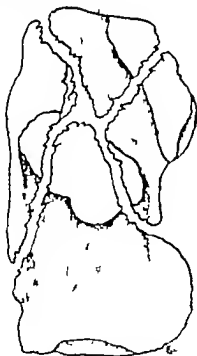


Fig. 1. Reconstruction of the upper surface of a badly fractured os calcis.



Fig. 2. Lateral view showing os calcis broken on wedgeshaped lower border of astragalus.

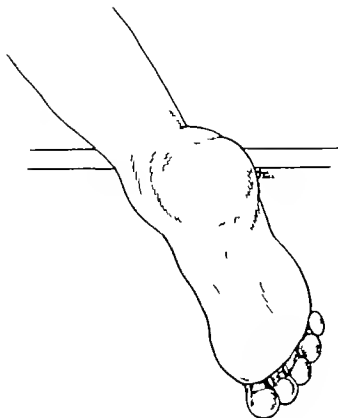


Fig. 5. Condition of foot at operation grossly edematous over heel.

patient lying prone an incision 5 inches long was made in the midline from 1 inch above the back of the os calcis over the point of the heel to the anterior end of the bone. In dissecting the two flaps care was taken not to separate the skin from the deep structures in order to preserve its blood supply. The plantar fascia was split longitudinally. The os calcis was sawed in two along its long axis and shelled out so as to leave intact the periosteum and the fibers of the Achilles tendon which pass over the bone to become continuous with the plantar fascia.



Fig. 6. Incision. Foot in sterile stockinette.

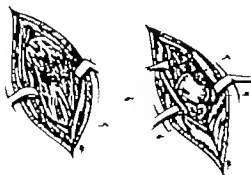


Fig. 7, left. Exposure of os calcis. A Cut edge of plantar fascia.

Fig. 8. Os calcis completely removed. Astragalus exposed. A astragalus B tendon peroneus longus C flexor hallucis longus D, flexor digitorum longus, E, soggy edematous tissue in joint, seen after removal of os calcis.

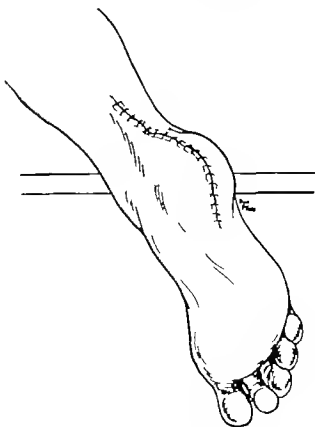


Fig. 9. Suture of wound. Incision closed. Restoration of normal outline.

The cortex of the os calcis was extremely thin and the fragments spike like, resembling a broken glass bottle. Figure 4 shows the fragments removed at an operation for excision of the os calcis.

The under surface of the astragalus could be easily seen and was not fractured. It was noted that there was great swelling and bruising of the soft tissues and it is undoubtedly the tension in them which leads to the fibrosis which causes so much stiffening of the joints and the small muscles. The operation not only removes the damaged bone and joint surface, but also relieves the soft tissue tension and reduces the general rigidity of the foot. The wound was closed by suturing the insertion of the Achilles tendon, now freed from bone, to the plantar fascia. The two halves of the periosteum and the skin and fascia were sutured in layers with cotton. Two gauze pads were placed on each side of the heel to maintain its natural shape and the usual dressings and a firm bandage were applied. The foot was then immobilized in plantar flexion with plaster of Paris.

When the plaster was removed 10 days later the wound was soundly healed and active movements were commenced. Two months after the operation the patient started walking, and was discharged after 3 months. A year later she walked well and was able to dance. At 18 months she walked without a limp, had no complaints, and stated that she was able to do anything. She could stand on tip-toe and when walking it was impossible to tell which foot had been injured. There was no loss of power and she had full range of inversion and eversion, and freely mobile metatarsal and toe joints. In appearance the foot was perfectly normal.

CASE 2. A man DGF, aged 62 years, fell a distance of 10 feet on to a concrete floor on December 21, 1942 and sustained a comminuted fracture of the left os calcis. He was operated on the next day and almost the whole os calcis was removed except the anterior inch. He was able to go back to work after 6 months and has been at work ever since. He walks normally and is able to run. He can stand on tip-toe and there is no visible lack of power in the left leg. The Achilles tendon appears to be as strong on the left side as the right. The appearance of the foot is good and all movement are excellent.

AFTER TREATMENT

The foot is immobilized in the original plaster for 1 month. The position of plantar flexion is to ensure relaxation of the Achilles tendon so that its new attachment is not strained. At the end of 4 weeks the sutures are removed and active nonweight bearing exercises are commenced. The important exercises are inversion, eversion and circumduction. Posttraumatic edema is prevented by insisting that the leg be not allowed to hang down during the 2 weeks immediately follow-

ing removal of the cast except during periods of exercise.

When the patient feels able to walk he is encouraged to do so. The average period is about 6 weeks. It is important to see that he is taught to walk correctly and without a limp.

RESULTS

This new method of treatment of fractures of the os calcis has been performed 15 times to date and the 2 cases reported were the first and therefore have been observed over a considerable time. Three years have now elapsed since the first operation was performed and this girl has an excellent result with practically no disability. The second patient, a bricklayer, has now been working for 2 years, without disability.

Two cases were not satisfactory. One a man aged 63 fell 14 feet from a plank directly on to his left heel with the knee straight. He sustained a very severely comminuted fracture of the left os calcis and the os calcis was removed. He made a very poor recovery and got causalgic pains in his leg and at a later date the leg had to be amputated. The section of the foot afterward showed that there was a condition of arteriosclerosis present and he had very poor circulation. There was arthritis in all joints of the foot which was completely stiff and rigid. Whatever treatment this man had he would have had a poor result. Another patient for whom the os calcis of both feet was removed was an old man who had fallen 20 feet and landed on his heels. He also had a very poor result. These were the only two really bad results out of the 15 cases I have done and all the rest of the patients are doing exceptionally well.

CONCLUSIONS

The results of this operation have been so gratifying that this preliminary report is published in order that others may try it. It probably should be reserved for the severely comminuted fractures and like other excisions of bones in the foot it is a somewhat difficult operation because of the strong ligaments attached to the bone. Unless one is careful to avoid a postoperative hematoma there is risk of sepsis. The operation should

be performed as soon as possible after the injury in order to prevent intrafascial tension from bleeding and edema which causes ischemia and subsequent congealing of the intrinsic muscles and leads to stiff midtarsal joints and stiff toes. Careful attention must be paid to the after treatment.

The chief advantages of this method are

- 1 Freedom from pain
- 2 Good range of inversion and eversion
- 3 Mobility of the whole foot
- 4 Good toe action
- 5 This operation will undoubtedly save many an injured foot from amputation

LARGE RETROPERITONEAL METASTASIS FROM A SO CALLED CARCINOID OF THE SMALL INTESTINE

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PAUL C. KIERNAN M.D., Rochester, Minnesota

CARCINOMAS of the small intestine are comparatively rare comprising about 3 per cent of all intestinal cancers. The so called carcinoid tumors constitute approximately a fourth of all malignant neoplasms of the small bowel. These tumors have also been termed argentaffinomas, chromaffinomas, paragangliomas and primary carcinomas. They occur at least two times more frequently in the appendix than in the small bowel. However this type of neoplasm has been known to occur in all locations of the gastrointestinal tract from cardia to anus. In the small intestine carcinoid tumors are characterized particularly by occurring in older persons and by the multiplicity of their primary lesions in contrast to the single primary lesions occurring in the appendix, which are seen most frequently in younger persons. The present report is concerned with a single small primary growth in the ileum with extension into the mesentery and a large retroperitoneal metastasis of both surgical and pathologic interest.

HISTORICAL ASPECTS

Credit is due to Lubarsch who in 1888 clearly distinguished these neoplasms from ordinary adenocarcinomas occurring in the gastrointestinal tract. He reported 2 cases of multiple nodules in the ileum and designated

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the lesions as primary carcinomas although they appeared somewhat atypical. Ransom in 1890 described 1 case resembling that of Lubarsch in which the neoplasm had spread into the mesentery and metastasized to the liver.

It was Oberndorfer who in 1907 termed these neoplasms carcinoids to express their malignant appearance in contrast to their benign clinical course. Based on a study of 6 cases of multiple tumors of the small bowel Oberndorfer's description of these neoplasms in summary is worth quoting in part in Forbus translation because some of the points may merit criticism in light of the behavior and character of lesions as reported since that time.

- 1 The tumors are usually multiple
- 2 The cells are largely undifferentiated masses but may show glandular form
- 3 They are circumscribed and have no tendency to infiltrate the surrounding tissue.
- 4 Growth is slow no large size being obtained.
- 5 The tumors are of a harmless character
- 6 They lie regularly in the submucosa with frequent projections into the mucosa.
- 7 The stroma is smooth muscle derived from muscularis.

We shall not comment in detail on the foregoing points of Oberndorfer's description suffice it to say that carcinoids certainly are not to be regarded as benign and harmless, especially when located in the small bowel.

In contrast to the conception of Oberndorfer and in support of Bunting, Burckhardt con-

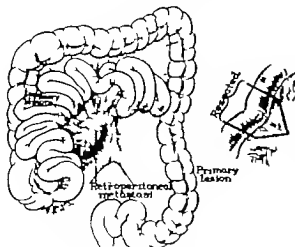


Fig. Relation of small bowel to the retroperitoneal mass.

considered these neoplasms definitely of basal cell character and analogous to the basal cell cancers of Krompecher. While microscopically resembling basal cell epitheliomas superficially, these tumors, unlike basal cell cancers, will definitely metastasize as is indicated in reports published within recent years.

ORIGIN OF THE SO CALLED CARCINOID TUMORS

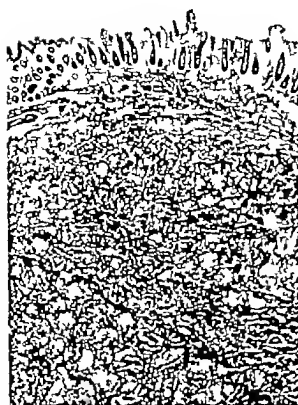
The exact cell or cells of origin of these tumors have not been conclusively demonstrated and authorities are not agreed. The weight of the evidence seems to be in favor of their origin from the argentaffin cells found distributed irregularly in the gastrointestinal tract and notably within the crypts of Lieberkuhn. The three types of granular cells located in the intestinal tract and described by Schmidt, Kulschitzky and Paneth all seem to be implicated as possible sources of these neoplasms. It was Gosset and Masson (7, 11) who first showed that certain cells situated at the bases of the crypts of Lieberkuhn reduce an ammoniacal solution of silver salts. The granules in these cells are stained by the chromaffin and silver impregnation methods and by various other stains, perhaps depending on their different functional stages. No explanation of the histogenesis of carcinoid tumors of the small intestine can be accepted without some degree of reservation (3). There may be a common cell of origin or any of the

three types mentioned earlier in this paragraph and described in detail by Kull may be their source under various situations.

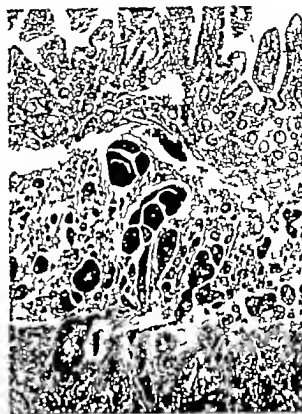
PATHOLOGIC ASPECTS OF SO CALLED CARCINOID TUMORS OF THE SMALL BOWEL

As mentioned previously these lesions occurring in the small intestine are frequently multiple and occur in an older age group than those found in the appendix, which are usually single (17). The primary tumors are characteristically small in contrast to the much larger metastatic foci. They are characteristically yellow and frequently one may suspect the diagnosis grossly after sectioning the lesions. Most frequently the lesions do extend into the mucosa and lumen of the bowel but this is not always so. In some cases the lesions seem to extend outward into the muscular coats with little or no projection into the lumen. Their growth in the intestinal wall results in kinking or angulation of the involved segments. Gross ulceration of mucosa may be absent a fact that explains the absence of intestinal bleeding in many of these cases.

Microscopically these tumors consist of cuboidal, spherical, or cylindrical cells arranged in small irregularly shaped groups or masses. The nuclei are vesicular and rounded or ovoid. The cell groups or nests are usually predominantly solid. The lesions are usually seen in the muscularis mucosae and extend into the mucosa and muscular coats of the intestinal wall. The cytoplasm of these cells has usually an indistinct border and is finely granular. These granules are both chromaffin and argentaffin. The cells on the outermost border of the masses or groups frequently may be seen to be arranged in parallel fashion and assume a cubical shape recalling a similar pattern seen in basal cell cancers. This feature is more prominent in the fresh frozen sections than in the fixed paraffin sections showing the tumor cells. The cytoplasm of the tumor cells may be finely vacuolated because of the presence of the lipid material to which the yellow color of the tumor is due. The relative uniformity of pattern of these groups or masses of cells, the lack of hyperchromatism, the regularity of their nuclei and partial opacity seem to indicate low malignancy. Close examina-



a



b

Fig. 2 a. Primary lesion showing tumor cells in and beneath the mucosa of the ileum (hematoxylin and eosin, $\times 27$)

b. Argentaffin tumor cells arising in mucosa of small bowel (Masson silver impregnation method, $\times 27$)

tion of the histopathologic features of these neoplasms of the small bowel does not seem of value in distinguishing those which have metastasized from those which have not metastasized and the picture seems to be similar in the two instances.

These neoplasms are carcinomas and are characterized by slow growth. Burckhardt remarked that "Metastasis from carcinoids is merely a matter of time." The malignancy of those in the small intestine is manifested much more frequently than the malignancy of those occurring in the appendix. Docherty, Ashburn, and Waugh (4, 5) noted metastasis in at least a third of their cases in which the neoplasm occurred in the ileum.

The carcinoid type of carcinoma spreads by the lymphatics and by venous invasion by the tumor cells. The likeness of these neoplasms to basal cell epitheliomas here terminates because the latter do not metastasize per meate lymphatics, or invade veins.

The term "carcinoid" may be a good term only so far as it distinguishes these neoplasms from other ordinary adenocarcinomas of the

intestinal tract. However, it should be emphasized again that these tumors are not harmless or benign but malignant and that they will infiltrate and metastasize and may eventually result in the death of the patient. Some reports of cases in recent years have even indicated disseminated metastasis as in the case reported by Watz. Even with metastasis in the liver and other widespread regions it should also be emphasized that provided the primary tumors are removed, the patient may live for many years in good health, as may be anticipated from the very slow growth of some of these tumors. In spite of their slow growth and mild clinical manifestations in many cases, we consider these neoplasms carcinomas.

CLINICAL ASPECTS

Symptoms, when present, are usually those of a chronic intestinal obstruction resulting from kinking of the involved segments of the bowel. Intussusception of the bowel may occur. Bleeding into the intestinal tract is most frequently absent. The patient is usually not very ill and most often loss of weight



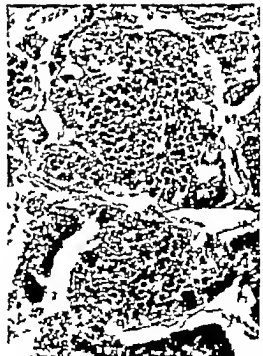
Fig. 3 a, Perusey al collection of tumor cells from mesenteric metastatic focus (hematoxylin and eosin, X180)



b, Not deeply stained endothelial cells lining perivascular space (Schmorl's method for chromaffin cells, X80).



Fig. 4 a, Tumor cells from retroperitoneal mass, similar to those in Figures 2 and 3 (hematoxylin and eosin,



X273) b, Argentaffin tumor cells from retroperitoneal mass (Masson silver impregnation method, X273).

is not pronounced. In some of these cases the neoplasms are reported as being silent but in the small bowel they frequently give symptoms of obstruction. Occasionally there may be a palpable abdominal tumor.

Roentgenographically, one may be able to demonstrate slight kinking and angulations of the involved portions of intestine associated with a small tumor projecting into the intestinal lumen. The kinking and the tumor may be the only signs demonstrable.

SURGICAL ASPECTS

The ideal surgical management for carcinomas of the carcinoid type involving the small bowel is resection of the segments of bowel containing the small single or multiple primary lesions with removal of all metastatic foci when feasible, including the involved lymph nodes. It is only in very rare instances because of the size and strategic location of metastatic masses, that it may be inadvisable to attempt their complete removal. However, when removal of the primary lesions has been performed, even with metastatic involvement, the prognosis may be good because of the slow growth of these neoplasms. When patients with metastatic foci located retroperitoneally in the liver or in other locations have had the segments of small bowel containing the primary tumors resected, followed by anastomosis of the remaining segments of bowel they have been known to live for many years.

It is important not to overlook multiple small primary lesions throughout the extent of the small bowel or even in the large bowel in these cases at the time of operation. The primary lesions may be very small and difficult to palpate but their presence may be manifested grossly by a slight kinking or angulation of the involved segment or segments of the bowel.

It is not possible to state whether removal of the primary tumor may have a beneficial effect on the metastatic foci from neoplasms of this type. Because of their slow growth metastatic tumors may be present for a long time without revealing their presence.

In summary the ideal form of surgical management seems to be as radical a removal of the primary lesions and any metastatic foci

as is feasible. When resectability is limited to removal of the primary tumor or tumors, the prognosis may be good and the patient may live for many years in health sufficiently satisfactory to carry on all normal activities in spite of even large metastatic foci.

REPORT OF CASE

The patient a former nurse was a woman 65 years of age who appeared in fair general health. She was first seen at the Mayo Clinic July 16, 1945 when she stated that she had been fairly well until 5 years ago at which time she became constipated and began to take daily laxatives. At no time had she noticed any bleeding from the gastrointestinal tract. A series of roentgenographic studies had been done and at this early period her condition was diagnosed as spastic colon. Two years ago she noticed no improvement and had a second series of roentgenograms taken. At this time she was told that there was nothing abnormal to be found in her intestinal tract. She had complained for the past year of pain in the right upper quadrant of her abdomen which had been relieved for short periods by colonic irrigations. She had not noted any bleeding or tarry stools. There had been no nausea or vomiting. There had been no jaundice or colic of any kind within recent years. Systemic review revealed a history of low back pain during the past year which she had noted most severely during change in position. Appendectomy had been performed 15 years ago and Ovarian cystectomy had been performed 4 years previously.

Physical examination. The systolic blood pressure was 140 millimeters of mercury and the diastolic pressure 88. The pulse 80 and the temperature 98.6 degrees F. The important physical findings were largely limited to the abdominal examination. There was a rather large cylindrical, firm slightly tender mass located in the midabdomen, extending longitudinally to the right of the midline and measuring approximately 10 centimeters in length and 6 centimeters in width. The mass was medial to the usual position of the cecum and was only slightly movable. No other masses were palpable.

Clinical studies were then made. The excretory urogram was essentially negative on each side. Studies of the colon also gave negative results and a simple roentgenogram showed only an opaque real due in the colon. The abdominal field was otherwise negative roentgenographically. Complete studies of the blood and urinalysis revealed normal findings.

Operative procedure (abstracted in part). Operation, consisting of resection of a portion of the ileum, ileostomy (side-to-side) and removal of a specimen from the retroperitoneal tumor for diagnosis was performed by one of us (P. C. K.) on August 7, 1945. The operative diagnosis was retroperitoneal malignancy. The tumor with involvement of the mesentery of the small bowel and primary lesion in the small bowel.

Examination of the stomach, colon and first portion of the duodenum gave negative results. The gall bladder was distended and thin walled but contained no stones. The liver and pancreas were normal. On examination of the pelvis, it was observed that the uterus was atrophic and the adnexa were negative to palpation. The small bowel was normal throughout the jejunum and upper part of the ileum but about the midileum the mesentery was much shortened and was attached to a retroperitoneal mass. There was a slight kinking or angulation in this portion of the ileum and a small nodule could be seen extending to the serosal surface. At this same segment of the ileum approximately 3 feet (91 cm.) of the lower portion of the ileum was closely adherent to this mass. The tumor although not completely fixed, involved the entire root of the mesentery of the small bowel and was closely adherent to the large vessels. Figure 1 illustrates diagrammatically the relative position of the retroperitoneal mass and its relationship to the small bowel. It was thought best not to attempt removal of the retroperitoneal mass. Approximately 3 feet (91 cm.) of the lower part of the ileum was resected including the involved indurated portion of the mesentery, the ends of the bowel were turned in and a side-to-side anastomosis was performed. The anastomosis was about 3 to 4 feet (91 to 122 cm.) proximal to the ileocecal valve and seemed satisfactory. The appendix had been removed previously elsewhere. Biopsy of two specimens from the retroperitoneal mass was performed for diagnosis.

Pathologic aspects The resected portion of the ileum contained a small rounded nodule measuring 1.4 by 1 centimeter located within the wall of the ileum and extending to the serosal surface and also several irregular nodules located within the mesentery of the ileum just beneath the primary lesion. The cut surface of the primary lesion was smooth and yellow and the lesion appeared to involve predominantly the submucosa and muscularis but did not project into the lumen of the small bowel. The involved mesentery was firm and irregularly shaped and appeared more whitish than the yellow primary lesion. The two small pieces of tissue from the retroperitoneal mass presented an occasional yellowish spot within their substance. Microscopically sections from the primary lesion from the involved mesentery and from the retroperitoneal mass were all similar and characteristic of those of carcinomas of the carcinoid type. The tumor cells were all microscopically identical in each location. The tumor cells were arranged in solid groups or masses made up predominantly of spherical cells. The cytoplasm was finely granular with indistinct cytoplasmic borders and the nuclei were small rounded or ovoid and vesicular. The fine granules within the cytoplasm of all these tumor cells in each location were both argentaffin and chromaffin. Figure 2 shows one of the sections taken from the small primary lesion within the wall of the ileum. Figure 3 illustrates one of the sections taken from the involved mesentery of

the ileum. Figure 4 is representative of one of the sections taken from the retroperitoneal mass. It is evident that the small lesion in the wall of the ileum was the primary site and that the nodules in the mesentery and the large retroperitoneal mass, which greatly exceeded the volume of the small primary lesion, were metastatic foci. All of these locations, including the primary lesion in the ileum showed carcinoma of the carcinoid type.

Postoperative course The postoperative course was uneventful and the patient was dismissed from the hospital August 14, 1945 and from the clinic August 24, 1945 in a satisfactory condition.

COMMENT

Some of the important surgical and pathologic aspects of carcinomas of the carcinoid type involving the small bowel have been previously discussed.

The case herein reported of a so called carcinoid presented several unusual features of both surgical and pathologic interest. It was illustrative in many respects of these tumors occurring in this portion of the small bowel except that in this case there was only a single primary lesion. However the rather extensive involvement of the mesentery and the large retroperitoneal metastasis were unusual features. The most unusual feature of this case was the strategic location of the large retroperitoneal mass at the root of the small intestine in proximity to the great vessels in such a manner so as to make its removal inadvisable to attempt. In spite of the fact that it was not possible to remove the large retroperitoneal mass, it was possible to remove the primary lesion and the involved mesentery and thus avert any future threat of obstruction which indeed is one of the most likely complications with neoplasms of this type involving the small bowel.

SUMMARY

A case of so called carcinoid of the ileum with a large retroperitoneal metastasis has been presented. The strategic location of the large retroperitoneal mass at the root of the mesentery of the small bowel prevented any attempt at excision but it was possible to remove the primary lesion in the ileum with the involved mesentery and thus relieve any further possibility of obstruction. The case presented illustrates well the fact that these neoplasms can no longer be regarded as benign.

DICKSON ET AL. RETROPERITONEAL METASTASIS

and harmless. We consider these so called carcinoids of the small bowel to be grade 1 (Broders method) carcinomas of the carcinoid type in order to distinguish them from the ordinary adenocarcinomas of the intestinal tract. Designation of these neoplasms as grade 1 carcinomas indicates their slow growth and low malignancy. It is felt that the histopathologic picture of those neoplasms which have metastasized is similar to the picture of those which have not metastasized. Therefore one is unable to predict on the histopathologic basis which of these neoplasms will metastasize.

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INTRATHORACIC TUMORS OF THE SYMPATHETIC NERVOUS SYSTEM

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NEOPLASMS of the sympathetic nervous system are widely distributed, having been reported as occurring in the adrenal (most frequent site) abdominal cervical, thoracic, and pelvic sympathetics the jejunum, celiac ganglion, mesentery, liver coccygeal body uterus, cavity of the nose skin and subcutaneous tissue, scapula region and carotid body. Their occurrence within the thorax while not rare, is still unusual enough to warrant their being classified as a curiosity by Gray and to justify the continued reporting of individual cases or small groups of cases. More often than not, they are symptomless their discovery being quite accidental. For this reason an accurate estimate of their incidence can not be made. Mass chest x ray surveys such as preinduction pre-employment, and school examinations will inevitably lead to the more frequent discovery of intrathoracic neoplasms, and their removal and consequent correct diagnosis will follow.

The present communication deals with the occurrence of these neoplasms, the embryology of the sympathetic nervous system in its relation to their formation, a discussion of their characteristics and a detailed report of 7 cases which have occurred at the University of Michigan Hospital. In addition the author has found 63 cases of intrathoracic sympathetic tumors reported in the literature. Of these 43 or 68.2 per cent were ganglioneuromas, 16 or 25.4 per cent sympathoblastomas (neuroblastoma) 2 or 3 per cent sympathogoniomas and 2 or 3 per cent pheochromocytomas.

OCCURRENCE

Gray states that in 1864 Knoebellanch reported the first ganglioneuroma in the case of a neuroma reported by Odier in 1803. The

tumor was undoubtedly a ganglion cell tumor. The first tumor from the sympathetic nervous system to be adequately described was reported by Virchow in 1864, designated by him as a glioma but believed by Wahl and others to have been a ganglioneuroma. Lorets in 1870 first described ganglioneuromas and reported the first intrathoracic case. But it was not until 1910 that Wright placed these tumors on a sound pathological basis. He called attention to a group of tumors, the nature of which had previously escaped general recognition, and he pointed out their distinguishing characteristics. He considered the essential cells of the tumors to be more or less differentiated nerve cells, neurocytes or neuroblasts, and designated these tumors as neurocytoma and neuroblastoma. Paragangliomas or the chromaffin tumors were first described by Mannasse in the suprarenal gland in 1893. Frankel in 1886 and Perley in 1890 described tumors apparently of this type.

True nerve tumors, i.e., growths consisting of specific nerve tissue elements, may occur in any part of the nervous structure. They may be benign or malignant and while they may differ widely in their structure, behavior and occurrence, yet they are closely related ontogenetically. Both the benign and malignant forms are well illustrated in the sympathetic system. The benign form includes the ganglioneuromas and the chromaffin tumors, in both of which the cells are more or less highly differentiated. The malignant form, not recognized as such until Wright's epochal work placed them in their proper category are the neurocytomas or neuroblastomas. The confused terminology of this group will be discussed later.

As previously stated, these tumors are as widely distributed in the body as the sympathetic nervous system itself but by far the greater number are to be found in the adrenal. Lewis and Geschickter studied 40 neuro-

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blastomas and found that 33 of them were in the medulla of the suprarenal gland, or in sympathetic ganglions adjacent to the medulla. Scott and Palmer reviewed the literature up to 1932 and found only 37 reported cases of sympathetic blastomatous tumors other than those in the adrenal medulla. Shultz in 1926 reported 53 cases of gangli-neuroma not in the adrenal. The number of these cases found in the chest is not stated by either author. Loretz's case in 1870 is the first thoracic sympathetic tumor reported. Reid lists 3 cases of intrathoracic neuroblastoma and 6 of ganglioneuroma reported up to 1928. Bigler and Hoyne reporting 1 case of their own in 1934, reviewed the literature up to that time and found 11 reported cases in the thorax out of a total of 164 cases of ganglioneuroma in various situations. James and Curtis found 33 reported cases up to 1941 and Skinner reporting 1 case in 1943 cites 37 in the literature. Wahl and Robinson state that up to 1943 only 13 cases of thoracic neuroblastoma have been reported out of about 200 cases in the entire literature. Paraganglioma are rare in adults and rarer in the chest, only 2 cases of thoracic origin having been recorded although Wahl and Robinson report an interesting case of a mediastinal neuroblastoma containing pheochromoblastomatous elements.

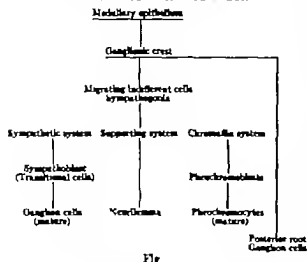
EMBRYOLOGY

A thorough understanding of sympathetic nerve tumors is dependent on a knowledge of the embryology of the sympathetic nervous system. According to Jordan the peripheral nervous system comprises nerves and ganglia outside the central nervous system. It includes (1) the cerebrospinal nerves and (2) the sympathetic nervous system. Constituent nerve fibers include both myelinated and unmyelinated varieties. The sympathetic ganglia of both the trunk and head arise from cells which migrate from the neural tube to their definitive positions. In the trunk region the ganglion cells migrate before the formation of definitive nerve fibers and during migration the cells are in an indifferent stage only later developing into either neuroblasts or support ing elements. It is well known that this

migration takes place at an early period of embryological development. In addition to the sympathetic neurocytes, the sympathetic primordium is also the progenitor of the chromaffin (pheochromic) cells. In the early stages of development the two can not be distinguished from each other. The chromaffin cells are characteristic of the paraganglia the medulla of the suprarenal and the carotid body, although their presence in the latter is denied by some. The paraganglia are formed from groups of these cells which have migrated along the entire sympathetic system. Some migrate to the dorsal surface of sympathetic ganglia where they form small rounded masses which become lodged in depressions in the ganglia. Other cells migrate to the kidneys, uterus, liver and testes while still others come to rest on the ventral surface of the abdominal sympathetic plexuses and differentiate into larger chromaffin bodies. The largest of these are the organs of Zuckerkandl which develop in the connective tissue along the sides of the aorta near the bifurcation. The chromaffin cells of the suprarenal medulla pass laterally from the celiac sympathetic plexus until they come in contact with the cortical cells which have developed from the celomic epithelium. The medullary cells then grow into the mass of cortical cells then growth beginning at about the 12 millimeter stage and continuing until after birth. According to Poll the development of ganglion cells from sympathogonia continues until the tenth year and thus may be a factor in the development of neoplastic conditions of the sympathetic system. These peripherally migrating nerve cells may come to rest almost anywhere in the body and are capable of proliferating and forming tumors at a later date in life.

Experimentally the origin of the sympathetic system has been proved by Harrison's historic work and confirmed by Van Campenbout. They showed that the removal of the entire neural crest from embryo Rana pipiens will result in total failure of development of the spinal and sympathetic ganglions throughout the trunk region. The motor neurons develop normally but are sheathless the chromaffin apparatus of the adrenal gland

EMBRYOLOGICAL DEVELOPMENT OF SYMPATHETIC NERVOUS SYSTEM



does not develop and there are no sympathetic nerve elements in the wall of the digestive tube.

A critical examination of the sympathetic primordia shows these elements to be totally undifferentiated. They are spherical in shape and possess round chromatin rich nuclei surrounded by scant cytoplasm. These cells have often been described as lymphoid cells and it is this lymphoid characteristic which undoubtedly led early observers to describe tumors composed of these cells as small round cell sarcomas or lymphosarcomas. Even at this early stage according to Bielschowsky these sympathogonia or undifferentiated neurocytes possess very delicate fibrils which are not as yet demonstrable by the silver staining method. Passing along to the next stage of maturation sympathogonia develop into sympathoblasts which are somewhat larger than the former possess a clearer almost vesicular nucleus and a somewhat larger protoplasmic body. In part they produce axones which may be demonstrated by the silver method in the form of fine threads and may be traced over long distances. The final stage of maturation is represented by the sympathetic ganglion cells in which the nucleus-plasma relation is largely in favor of the cell body. The cells possess predominantly a multipolar form and exhibit a varied manner of branching of their processes. They contain intra-

cellular fibrils and chromophile Nissl clumps. These nerve cells are enclosed in a connective tissue capsule and are surrounded by gliogenic satellites.

The embryogenic factor of importance in the understanding of the histopathological findings in sympathetic neoplasms is the rôle played by the sympathogonia. They have been assigned a place in the scheme of development comparable to the rôle of the medulloblast in the developing central nervous system. Schaper was the first to hypothesize indifferent cells, derived from the medullary epithelium, bipotential in their possibilities, and developing into either spongioblasts or neuroblasts. While many workers deny the existence of the medulloblast His accepted these cells but he did not believe them to be bipotential. He believed, rather that each cell was unipotent and was predestined from the beginning to become a spongioblast or a neuroblast. Bailey and Cushing believed that Schaper's hypothesis was necessary for a proper comprehension of the normal histogenesis of the brain of malformations of the brain and of brain tumors. Having been generally accepted this theory is likewise essential to a proper understanding of the developing sympathetic nervous system and its abnormalities. Sympathogonia, then, are generally considered as indifferent cells, prioripotent in their possibilities and the mother cells of (a) sympathoblasts and sympathetic ganglion cells (b) the chromaffin (pheochromic) cell structures which are the pheochromocytes of the adrenal medulla, the paraganglionic bodies and other structures and (c) the immature glial cells of the sympathetic nervous system, the astroblasts, which ripen into mature supporting units, the astrocytes. The genetic elements comprising the sympathetic nervous system are expressed schematically in Figure 1.

Martius in 1913 described a tumor in which he found both a high degree of differentiation of the fibrillae and the presence of many cells that corresponded to Poll's sympathoblasts. He called this tumor a sympathoblastoma and looked upon it as affording the missing link between ganglioneuroma and the malignant neuroblastoma.

CLASSIFICATION

Inasmuch as it has been demonstrated that the sympathetic nervous system is developed by a progressive growth of and a differentiation from the pluripotential mother cells, the sympathogonia, it is to be expected that tumors arising during the process of differentiation may contain cells in varying degrees of maturity. This naturally produces new growths difficult of classification, as the tumors rarely contain a single cell type. Various transitions between different forms have been reported and two or three types may be present in one tumor. Numerous classifications have been offered and even a casual review of what has been written on the subject serves to convince the reader of the confusion which exists. Wahl in 1914 Dunn in 1914 1915 Lehman in 1922 Symmers in 1936 and others have classified cases as neuroblastomas ganglioneuromas and chromaffinomas. Von Fischer in 1922 classified the group according to degree of differentiation. Scott and Palmer in 1932 base their classification on the plan proposed by Bailey and Cushing for tumors of the central nervous system. Bielschowsky believes that a simple classification is best and that any attempt to subdivide on a basis of degree of immaturity only adds to the confusion and his classification is the simplest one found. Robertson in 1915 correlated the terms used by previous authors. 'Neurocytoma' (Marchand) = neuroblastoma (Wright) = 'sympathicoblastoma' or 'ganglioma embryonale sympathicum' (Pick) = 'sympathogonioma' (Kohler) = 'sympathicoblastoma' (Robertson). Bailey and Cushing prefer the term 'sympathicoblast' for the primitive pluripotential cell before it has taken on the characteristics of a unipolar neuroblast and they use the term 'sympathicoblastoma' instead of 'neuroblastoma' for all tumors in which the cellular elements are of the undifferentiated type. They feel that 'sympathicoblastoma' more definitely places these tumors because the term 'neuroblastoma' is used also to describe certain cerebral neoplasms. Further all the primitive cells are not potential neuroblasts since some differentiate into chromaffin cells. On this basis Blacklock classifies all cases, exclusive of the

CLASSIFICATION OF SYMPATHETIC TUMORS (BIELSCHOWSKY)

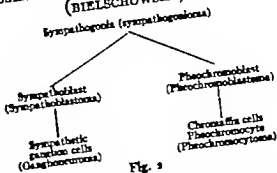


Fig. 3

chromaffinomas, into sympathicoblastomas (all malignant) and ganglioneuromas (generally simple and benign). The former he subdivides into (1) undifferentiated (composed only of sympathogonia) and (2) differentiated. The differentiated he again subdivides into those which are composed of sympathogonia and sympathoblasts and those containing ganglion cells in addition to the primitive cells. These he terms ganglioma sympathicoblastoma. From a practical clinical and pathological point of view Bielschowsky's simple classification is appealing. Schematically it is represented in Figure 2. Bielschowsky makes no attempt to subdivide the tumors according to the various degrees of differentiation as is done by some authors. As has been repeatedly stressed, these tumors are composed of more than one cell type and a thorough understanding of the embryology with the designation of the neoplasm according to the predominant type of cell present, should serve to give one a clear picture of the pathological process.

DISCUSSION

A discussion of sympathetic nerve tumors on a basis of any of the various classifications available is very difficult. However from a review of all available descriptions of the microscopic appearance of the reported tumors I believe that the names neuroblastoma, sympathoblastoma, and sympathicoblastoma have been used interchangeably to designate the immature type of tumor. Usually no attempt has been made to separate these immature tumors into those composed entirely or predominantly of sympathogonia (sympathogonioma), and those in which the

TABLE L.—INCIDENCE ACCORDING TO AGE AND SEX—63 REPORTED CASES

Age group Years	Sympathogonioma				Sympathoblastoma				Ganglioneuroma				Pheochromocytoma			
	No.	Per cent	M	F	No.	Per cent	M	F	No.	Per cent	M	F	No.	Per cent	M	F
70		30				75	7	3		43	9					
70-80									9		3					
80-90									3	6.9						
90-100						6.1			4	9.4		3		100		
100-110						12.4										
Over 110		30				0.2			3	6.9						
Not given									3	6.9						
Total		100			15	60	19	4	43	100	7	30		100		

*Not stated—4 cases

**Not stated—0 cases

sympathoblast (sympathoblastoma) in various degrees of maturity is the predominant cell. The present discussion follows Biel schowsky's simple classification (Fig. 2).

Sympathogonioma. As is to be expected the sympathogoniomas are very malignant. Found most commonly as a primary growth in one or both adrenals, their occurrence in the chest is rare, Sailer and Andrus having reported the only cases. However taking the factors mentioned in the preceding paragraph into consideration one is justified in assuming that other sympathogoniomas are present in the group reported as neuroblastoma or sympathoblastoma. The case reported by Stariz and Abrams is an example. This was a 3 year old child who died and at autopsy extensive metastases to the lymph nodes and bones were found. Microscopically the tumor was composed almost entirely of small round cells with scant cytoplasm, typically sympathogonia. Because of their highly malignant nature they are found most commonly in the newborn and in youth rarely in adults. Paradoxically enough, Sailer's case was in a woman of 65 years of age.

Sympathogonioma are extremely cellular being composed of the closely packed lymphoid type of cell previously described. Very little supporting structure is seen. There is a tendency to rosette formation, Lewis and Geschickter having found rosettes in one-third of their cases and Wahl reporting them in one-half of the cases studied by him. Metastases usually occur early and are widespread, being found most frequently in the

lymph nodes long bones, skull brain, and liver.

Sympathoblastoma. Sympathoblastomas, differing only in that they represent greater maturity are somewhat less malignant and usually are found at a somewhat older age. Scott and Palmer reporting on 13 sympathetic tumors other than those in the adrenal gland found that 5 or 38 per cent, were in children 3 years old or younger as compared to 11 or 58 per cent, of 19 sympathogoniomas in the same age group. Intrathoracic sympathoblastomas are rare occurring in only 16 of the 63 cases of sympathetic nerve tumors found recorded to date an incidence of 25.5 per cent. This includes the case of Wahl and Robinson which contained pheochromoblastomatous elements and Cushing and Wollbach's case which was of the dumbbell type the intrathoracic portion being a sympathoblastoma and the intra-spinal portion (removed 10 years after the intrathoracic operation) a ganglioneuroma. The age limits were from 12 weeks to 48 years, 12 of the 16 cases or 75 per cent occurring in children under 10 years of age.

Blacklock states that no tumor composed only of sympathoblasts has yet been reported. While these cells usually predominate in the over-all picture sympathetic ganglion cells in all degrees of differentiation are encountered. Sympathogonia, sympathoblasts, immature ganglion cells, and mature ganglion cells may be present in one section. On the other hand, sections from different parts of the same tumor may present only one cell type and

unless blocks are cut from various parts and studied an entirely erroneous diagnosis may be made. Not as cellular as the sympathogonia, these tumors may contain large numbers of nerve fibrils. Differential stains such as silver impregnation, chrome salts and connective tissue stains are often necessary for complete classification. Metastasizing much more slowly than the sympathogonioma, they are more apt to show local invasive tendencies. Their metastasizing tendencies, however, are as varied as their microscopic picture.

Ganglioneuroma. Passing on to the mature tumors we have the ganglioneuroma. In these the neurocytic elements have differentiated into ganglion cells rich in plasma. Contrary to the opinion expressed by Bohrer and Lincoln this tumor is far from rare among children. Shultz reported 53 cases of ganglioneuroma not in the adrenal gland. Twenty-four were in adults, 21 in children and in 8 the age was not stated. In the intrathoracic cases the age varied from 1 to 73 years. 21 out of 43 cases or 48.8 per cent, being 10 years of age or younger and 29 or 67.4 per cent, under 20. In 3 additional cases the age is not given although one is stated to be a child. In none of these tumors, however, can age *per se* be said to be of great importance as all are due to embryonic rests, the age given representing only the age at which they are discovered. Sex also is unimportant, 12 of the cases being in females, 11 in males and in 6 the sex was not stated (Table 1).

Ganglioneuromas vary in size, the reported tumors ranging from that of a hen's egg to that of a child's head. Usually of firm consistency and well encapsulated, degenerative changes may give the tumor a soft feel beneath a firm outer shell. The cut surface may show lobulation and its color varies according to the degree of vascularity. Usually they are relatively avascular and present a grayish white to gray glistening appearance. Microscopically the picture is usually one of rather coarsely arranged fibrous tissue mixed with strands of medullated and nonmedullated nerve fibers, the latter predominating as a rule. Multipolar ganglion cells in varying numbers are found scattered throughout

Some areas may be very cellular while in others only an occasional ganglion cell is seen. These areas vary not only in different tumors, but in different parts of the same tumor. Not infrequently multinucleated ganglion cells are seen indicating an element of immaturity. In addition, tumors are encountered in which varying numbers of ganglion cells are present in a growth which otherwise has all the criteria of a fibrous tissue growth. To these the name ganglion neurofibroma or ganglionated neurofibroma has been given by some pathologists. Cases 3, 4, 6 and 7, reported in this article represent this type.

Usually considered as benign tumors malignant ganglioneuromas have been reported. These are due to an abundant intermixture of immature ganglion cells and have been designated as ganglioneuroblastoma.

Chromaffin tumors. Chromaffin tumors which Lewis and Geschickter consider the most common tumors of the sympathetic system are exceedingly rare within the thorax, only 2 cases having been reported, that of Miller in 1924 and Phillip's case in 1940. The case of Wahl and Robinson previously mentioned did contain chromaffin elements although the authors classified it as a sympathoblastoma. Their most distinguishing feature is, of course, their affinity for chrome salts. The large polyhedral cells in a richly vascularized fibrous tissue stroma show a granular cytoplasm and a large nucleolus usually containing one large nucleolus. Sections fixed in Orth's solution which contains potassium dichromate stain the cytoplasmic granules a golden yellow.

Dumbbell tumors. Tumors which present both in the chest and in the spinal canal, the so-called dumbbell or hourglass tumors, have been described. They are of fairly frequent occurrence, particularly among the ganglioneuromas. While an intrathoracic growth may conceivably grow into one or more of the vertebral foramina, I believe that these tumors are more accurately accounted for on an embryological basis, either from an embryonic rest of the migrating indifferent cells or from the ganglionic elements of an intercostal nerve. Quite frequently it is the pressure of the spinal segment of the tumor

on the cord which brings the condition to the attention of the patient. They are found more frequently in children. Eden in his paper devoted to this type of tumor reports an interesting case of a man 23 years of age whose first symptoms dated back to age 5 when a radiographic opacity in the chest had been diagnosed as an irreducible sarcoma of the spine. During the intervening 18 years, he had been free of symptoms but finally presented himself for treatment because of leg weakness and difficulty in urinating the same symptoms which had called attention to the tumor many years before. At operation the tumor was found to be a ganglioneuroma, dumbbell type.

Unusual types. Martius (quoted by Dunn) in 1913 described a case in which a malignant neuroblastoma was removed surgically from the lower part of the neck, and, on subsequent postmortem examination another part of the same tumor in the uppermost part of the thorax was found to be a ganglioneuroma. Furthermore Suzuki 1910 Hedinger 1911 and Wahl 1914 have reported cases in which sympathogonia, ganglion cells and chromaffin cells were all present in the same growth. Wahl and Craig have also found that these tumors may be multicentric. While usually of the same type, all three types (neuroblastoma, ganglioneuroma, and paraganglioma) may be present, occurring independently of each other. They report a case of a 28 year old man in whom three separate growths were found (1) a ganglioneuroma of the sigmoid colon (2) a neuroblastoma in the pelvis and (3) a ganglioneuroblastoma in another part of the pelvis. The only multicentric tumor involving the chest is that reported by Bigler and Hoyne, a mediastinal ganglioneuroma with another located under the right clavicle.

Neurofibromas. Finally one must not lose sight of the fact that any of the intrathoracic neurogenic tumors may have their origin from the sympathetic nervous system. In speaking of sympathetic nerve tumors, one instinctively thinks only of the immature and mature ganglion cell tumors already described. However reference to Figure 1 clearly indicates that all the neurogenic elements found in the neurofibromas, schwannomas, etc. are de-

rived from the ganglionic crest. In addition to this, even though the neoplasm may grossly appear to originate from an intercostal nerve, it must be remembered that intercostal nerves are derived partly from the ganglions of the posterior roots, which ganglions arise from the medullary epithelium by way of the neural crest. There are two schools of thought regarding the origin of neurofibromas, one group who note the presence of collagen and reticulum fibers and regard them as true mesoblastic fibromas, and the second group who trace all the tumors to neural elements, especially the Schwann cells, endoneurium and the lamellar sheath. In either case they may be derived from the sympathetic system and thus subject to classification under this heading. In this connection, a recent case report by Blades and Dugan is of interest. Two neurofibromas were found on the upper sympathetic chain within the thorax and one on the left vagus below the recurrent nerve. In addition, this patient had *café au lait spots* in both axillae and on the chest, typical stigma of von Recklinghausen's neurofibromatosis. Removal was without incident. In spite of the definite possibility of their sympathetic origin, no classification has yet been offered which makes provision for the inclusion of this large group of tumors. In fact, they are not usually considered as sympathetic nerve tumors. The increased incidence of the removal of intrathoracic neurogenic neoplasms will undoubtedly stimulate further study of these growths and lead to a more accurate classification.

CASE REPORTS

Seven cases of intrathoracic sympathetic nerve tumors have been found in the records of the University Hospital and they are reported somewhat in detail here.

CASE 1. E. L. H. No. 372334, a 7 year old school girl, was admitted to the University Hospital on October 24, 1935. Her chief complaint was pain in the left side of the chest. The pain began about 1 1/2 years previously and had increased gradually up to the time of admission. For the past year there had been shortness of breath on exertion and she had failed to gain weight. One month previously she had had an unexplained period of fever up to 103 degrees and an x ray film of the chest disclosed a tumor in the left hemithorax. Essential physical findings were heart displaced to right, the right border of

cardiac dullness being 1 centimeter medial to the right nipple line and the left border of cardiac dullness shaded into the flatness of the lower part of the left chest. Heart sounds were normal. The left chest was flat to percussion below the left second rib anteriorly the fourth rib in the axilla, and the fifth and sixth posteriorly. Below this line breath sounds were absent. Tactile and vocal fremitus were absent. In the abdomen fullness was demonstrated in the left upper quadrant and the spleen could be palpated below what appeared to be a tumor mass. The Kahn reaction and all routine laboratory tests were within normal limits. The vital capacity was 675 cubic centimeters coagulation time 6 minutes. X-ray examination revealed a gross tumor mass in the left upper abdomen and lower thorax apparently displacing the spleen and kidney down and the diaphragm up. The position of the mass was predominantly posterior. There was no evidence of skeletal involvement. Deep x-ray therapy had been given without benefit elsewhere before admission. Operation was performed on October 28 1933 by Dr. John Alexander. Removal of a firm tumor which was retropleural and attached to the entire anterior surface of the diaphragm and to the entire posterior diameter of the mediastinum except in the far anterior portion. Only moderate bleeding occurred all of which was relatively easy to control. Patient withstood the operative procedure well but died 1 hour postoperatively of hemorrhage.

Pathological report No. 2902 AN. A large encapsulated tumor 17 by 12 by 5 centimeters, weighing 1150 grams. Smooth surface lobulated on one side. On cut section surface is yellow gray. Microscopic diagnosis ganglioneuroma.

CASE 2 B. L. No. 472537 a white girl, aged 8 years, was admitted to the University Hospital on January 8 1941. This patient apparently had no symptoms referable to the chest. She was seen elsewhere in December 1940, with the complaint that during the past 4 years the feet had become deformed and interfered with walking. She had a pes equinus deformity. In the course of her check up examination a chest x-ray film was made and showed a complete opacity of the left hemithorax with displacement of the heart and mediastinum to the right. In the standard films, it was impossible to differentiate between a massive tumor and fluid. Later grid films showed a well circumscribed encapsulated mass in the posterior portion of the left hemithorax. There appeared to be numerous flecks of calcium within the mass. At fluoroscopy it was felt that the mass contained fluid and a thoracentesis was done but no fluid was obtained. Following the thoracentesis there was a sharp rise in temperature to 102 degrees and the pulse rate reached 160. Two days later an exploratory thoracotomy was done and the biopsy material obtained revealed a ganglioneuroma. The child was then sent to the University Hospital for removal of the tumor. The past history was noncontributory except for the fact that the child had had measles with a com-

plicating pneumonia 2 years previously. She was never really well after this, being nervous and irritable and had a poor appetite. The physical examination showed only a poorly nourished girl of 8 years with a pes equinus deformity of both feet. No other abnormalities were noted except in the chest where the findings were compatible with the lesion revealed by the x-ray examination. Routine laboratory tests were within normal limits. The Kahn test was negative.

Operation was performed February 14 1941 by Dr. Cameron Haight. The chest was opened through the usual posterolateral incision. The tumor mass exposed was a very firm one. In the scapular line the subjacent tumor was adherent to the parietal pleura but in the anterior axillary line a free pleural space was present. The anterior portion of the tumor was not adherent to the lung which was crowded into the anterior portion of the pleural cavity. The sixth intercostal nerve entered the capsule. The tumor extended from the third rib posteriorly to the diaphragm. Deep fingerlike processes of tumor extended into the eighth ninth and tenth intercostal spaces adjacent to the spine. The mass was removed by blunt and sharp dissection and at about the time it was removed respirations suddenly ceased. Only a limited autopsy was obtainable and from this it was impossible to determine if the spinal canal had been invaded by the growth. No regional metastases were present. Grossly this was a large oval-shaped encapsulated tumor presenting irregular nodes on the surface and on section a uniform waxy and fibrous, yellowish tissue. Its weight was 595 grams and it measured 16 by 10 by 6½ centimeters.

Microscopic examination pathological report No. 4305 AS. The tumor is made up of countless large ganglion cells which frequently contain two or more nuclei and numerous bundles of peripheral nerves lying in a dense connective tissue stroma and showing areas of secondary calcification and perivascular inflammation. Diagnosis peripheral ganglioneuroma.

This was a typical ganglioneuroma showing a relative amount of immaturity as evidenced by the frequent multinucleated ganglion cells seen.

CASE 3 T. O. No. 486332 white schoolboy aged 11 years was admitted July 31 1941. This boy had no symptoms either past or present as a result of the neoplasm present in his chest. A routine tuberculin test at school in May 1941 was positive and for that reason a chest x-ray film was made. This film showed the presence of a tumor mass in the left hemithorax. On admission, physical examination was negative except for the chest. There were diminished breath sounds at the left apex, extending down to the second anterior rib. There was impaired resonance but normal fremitus over this area. No rales were heard. Posteriorly there was dullness

diminished breath sounds, and whispered voice sounds down to the sixth rib. The blood Kahn reaction was negative and all routine laboratory tests were within normal limits. X ray examination of the chest showed a rounded mass in the upper portion of the left hemithorax extending as low as the anterior portion of the third interspace. Some erosion of the posterior portion of the third rib was visualized. Oblique and lateral views showed the large mass to lie far posteriorly and adjacent to the vertebral column.

Operation was performed on August 1, 1941 by Dr. John Alexander. The approach was posterolateral through the bed of the fourth rib with resection of about 6 centimeters of the third rib. A slightly soft and completely encapsulated neoplasm was found in the costovertebral gutter extending from below the dome of the pleural cavity to the level of the fifth posterior intercostal space. After dividing the parietal pleura around the base of the tumor it was readily removed by blunt dissection, the removal including a lobulation which projected into the mediastinum. The pedicle of the tumor appeared to be at the level of the third intravertebral foramen and the third and fourth transverse processes were removed to expose this foramen. The tumor was seen to traverse this foramen, which was larger than normal. Portions of the lamina were removed and at a depth of 1.5 centimeters in the foramen, the tumor was seen to taper off to a point and was removed completely. Recovery was uneventful and the patient left the hospital on the sixteenth postoperative day. He has remained entirely well to date.

Pathological report, No. 666 AT. Microscopically routine hematoxylin and eosin stained slides show a stroma having the appearance of a neurofibroma and containing large numbers of typical ganglion cells. Diagnosis, ganglionated neurofibroma.

This was another case of a rather large tumor which was symptomless and discovered only accidentally. It was almost a dumbbell type extending for a short distance into the intervertebral foramen.

CASE 4. K. T. No. 536736 white boy aged 13 years, was admitted December 5, 1933. This patient had no chest symptoms. A short time before this admission he had had a fall and x ray films of his shoulder were made. These revealed an intra-thoracic neoplasm and he was referred to the University Hospital for its removal. The rest of the history is noncontributory except for the presence of a long standing and very extensive eczema. Physical examination showed very little. There were some palpable enlarged lymph nodes in the neck and both axillae. A diffuse dry scaly eczema was noted over the greater part of the body and extremities. There were dullness to percussion and diminished breath sounds over the upper left chest both anteriorly and posteriorly. The rest of the examination was nega-

tive. The blood Kahn reaction was negative and other routine laboratory examinations were within normal limits. X ray examination of the chest revealed a fairly extensive homogeneous obscuration of the upper portion of the left hemithorax, more marked in its median aspect. Films of the dorsal spine revealed extensive erosion of the upper dorsal vertebral bodies. The erosion began at the level of second dorsal vertebra and extended downwards as far as the sixth dorsal vertebra. The left lateral and posterior aspects of the vertebral bodies were involved and the abnormality was in the form of scalloping of the margins of these bodies. There appeared to be associated widening of the anteroposterior diameter of the spinal canal in the region of the vertebral erosion and there was also associated erosion of the vertebral and posterior portions of the third, fourth and fifth ribs.

Operation was performed December 10, 1943 by Dr. John Alexander. A posterior approach was used with the incision extending from the second rib over the sacrospinalis muscle downward to the seventh rib and laterally beyond the inferior angle of the scapula. On the posterior surface of the sacrospinalis muscle from the level of the third to the fifth posterior ribs a neurofibromatous lesion was visible. This lesion in the muscle was completely removed, together with the adjacent muscle tissue. This had a vertical length of approximately 4 centimeters and a horizontal width of approximately 3 centimeters. This was later seen to have arisen from the main tumor mass at the level of the extreme posterior third intercostal space. It was necessary to remove, subperiosteally, the posterior 10 centimeters of the fourth, fifth, and sixth ribs. Also the head and neck of the fourth rib were removed so as to give maximum exposure of the third and fourth intervertebral foramen where the tumor tissue was applied singly to the foramen. The tumor appeared to be attached to the third, fourth, fifth, and sixth intercostal nerves at their emergence from the intervertebral foramina. By blunt and sharp dissection the tumor was finally removed from its bed. Usual closure without drainage. The postoperative period was rather stormy and a left-sided empyema had to be drained on the fifteenth day. The ultimate recovery was complete however and the present condition is excellent.

Pathological report No. 2465 AV. Hematoxylin and eosin stain. Sections show large fragments of a neurofibroma. Some of the stroma is edematous and much of it shows early hyaline change. In one section numerous ganglion cells are scattered through the neurofibromatous elements. There was no invasion of the attached muscle and bone fragments. Diagnosis, ganglionated neurofibroma.

CASE 5. J. S. No. 551083 white male, aged 39 years, was admitted to the University Hospital July 6, 1944. The chief complaint was extreme dyspnea. In March, 1944, he began to have pain in the right chest which persisted to date. In addition there were cough and fever the temperature rising to 103

degrees. Cough was productive and the sputum was streaked with bright red blood. The fever lasted for 2 weeks and then returned to normal. The condition was diagnosed as pneumonia. Although the other symptoms subsided the pain remained and an x ray examination of the chest was made. It revealed a "tumor of the right lung. Eleven deep x ray therapy treatments were given without effect. The pain gradually became more severe. It was both dull and sharp. Worse in the right chest it radiated at times to the right arm. The amount of sputum increased until it totaled about one-half cupful a day. It was purulent but not foul. For the week before admission there had been some edema of the feet and ankles. Because of the pain and dyspnea, the patient could not lie down. On admission he was in extreme dyspnea and mildly cyanotic. During the 4 days before operation he was kept constantly on intranasal oxygen. The Kahn reaction was negative and all routine laboratory procedures were within normal limits.

Operation was performed by Dr. John Alexander on July 10, 1944. When the chest was opened a large tumor was found filling the upper half of the right hemithorax. Its size was estimated as about 12 by 12 by 12 centimeters. The right lung was displaced downward and the upper mediastinum to the left. The tumor was "frozen" to the mediastinum and to the spine. Removal was impossible. It was impossible to determine whether the mass was merely "frozen" to the mediastinum and spine or whether it was infiltrating these structures. The inside of the tumor was completely degenerated. The degenerated inner portion of the mass was evacuated and about 52 per cent of the wall was removed in order to relieve the pressure on the trachea and great vessels of the upper mediastinum. Dyspnea was greatly improved. Recovery was uneventful there being one thoracentesis for the removal of a few hundred cubic centimeters of fluid. He was discharged on the thirteenth postoperative day. The subsequent course was downhill and death was reported to have occurred within a few months. There was no autopsy.

Pathological diagnosis No. 100 AW Sympathoblastoma

CASE 6 J. L. N. No. 562795 white schoolboy aged 16 years had neoplasm producing no symptoms. The tumor was discovered when a chest x ray film was taken at school in a routine tuberculosis survey. He was then referred to the University for surgical treatment. The past history was noncontributory. The physical examination was negative except for the chest. Posteriorly there was increasing dullness to flatness from the second rib down to the seventh. Decreased breath sounds over this same area. The blood Kahn reaction was negative and all routine laboratory tests were within normal limits. A x ray examination showed a large mass which was fairly smoothly rounded anteriorly and which lay in the posterior portion of the left hemithorax and extended from the level of the third or fourth dorsal vertebra

as far down as the tenth dorsal vertebra. This mass was of homogeneous density and in lateral view it was seen to lie far posteriorly. There was considerable bony architectural change. This consisted of abnormality of the structural character of the fourth, fifth, and sixth vertebrae. There was suggestive evidence of widening of the neural canal between fifth and sixth dorsal vertebrae and definite abnormality of the left sixth and seventh ribs posteriorly. There was what appeared to be loss of vertical height of the sixth dorsal vertebra in the anteroposterior view and in the lateral view there appeared to be some loss in vertical height of fifth dorsal vertebra and possibly also of the seventh. In addition the intervertebral disc space between the fifth and sixth dorsal vertebrae was not easily identified and the pedicle on the left of the fifth dorsal vertebra appeared to be absent. In part, the changes appeared to be due to erosion, probably due to pressure, and in part they may be due to congenital malformation. The changes did not suggest invasion of the vertebra by neoplasm.

Operation was performed by Dr. Cameron Haight on February 10, 1945. The approach to the tumor was posterolateral through the bed of the resected fifth rib. The large tumor mass was partially adherent to the parietal pleura and it occupied the posterior half of the chest at the level of the resected rib. The lung was crowded forward by the tumor. The tumor was of a firm consistency and had a yellow color. On its surface were scattered areas of organized fibrin. The tumor was removed by blunt and sharp dissection. During its removal it was seen that the sympathetic chain and the fifth and sixth intercostal nerves were all either incorporated in or attached to the mass. They were removed with the mass. After the removal of the tumor it was seen that a nodule projecting from the surface of the tumor had caused an erosion of the fifth intervertebral foramen and had exposed the epidural veins over an area of about 1.5 centimeters. Recovery was uneventful and the patient left the hospital on the thirteenth postoperative day.

Pathological report, No. 3853 AW. The specimen consisted of a grapefruit sized, well encapsulated mass which on section had a firm, whitish appearance. Microscopic, a large neurofibroma with a few ganglion cells. Diagnosis: ganglionated neurofibroma.

CASE 7 D. S. No. 564033 was admitted February 14, 1945. This 2 year old boy was seen first in the Department of Pediatrics. He had been in perfectly normal health until 4 weeks before admission at which time the mother noticed that he dragged his left leg. Soon afterward he began dragging his right leg also and then ceased to walk entirely. This condition progressed rather rapidly until he soon was unable to sit up but he complained of no pain. The mother noticed however that there was increased irritability. There was no incontinence of urine or feces. Two weeks before admission he was seen elsewhere and a diagnosis of spinal cord tumor

was made. He was then referred to the University Hospital for treatment. Physical examination revealed a well developed white boy who did not appear acutely ill but who was unable to walk or sit up. All findings, including funduscopic examination of the eyes were negative except the following. Extremities showed bilateral paralysis of the legs. The patella reflexes were greatly hyperactive. The right leg offered some resistance when bent. The ankles were quite stiff. The left leg responded markedly when the Babinski test was tried. The right responded with spreading of all toes on trial of the same test. There was no diminution of pain sense. The blood Kahn test was negative as was the tuberculin test. All other routine laboratory examinations showed results within normal limits. X ray examination of the chest revealed a huge solitary well defined tumor occupying the left upper chest with displacement of the mediastinum to the right. Finely dispersed calcification was present throughout the mass. Detail films of the spine showed no abnormality.

A lumbar puncture was done on the day after admission and bloody spinal fluid was obtained. There was evidence of a partial block.

The child was seen in consultation by the departments of neurology, neurosurgery and thoracic surgery. It was agreed that the first attack should be directed toward removal of the spinal cord pressure, after which, removal of the intrathoracic portion of the mass would be attempted. The child seemed to remain perfectly well until February 16 at which time he developed a cough and evidence of an acute bronchitis. In spite of vigorous treatment he developed increasing respiratory difficulty and died on February 27.

Autopsy report. Only the pertinent facts pertaining to the neoplasm will be recorded here. All other findings were essentially normal and no evidence of metastases was found. "In the left pleural cavity is a neoplasm measuring 10 centimeters in diameter. It is round. There are numerous widely dilated blood vessels coursing over the surface of this neoplasm. The surface is a dull reddish-purple in color and glistening. It is firmly attached at the upper pole to the apex of the left pleural cavity by firm fibrous adhesions. It somewhat compresses the left subclavian artery which courses over its superior surface. There are several pale, white, oval bodies attached to the superior surface which appear to be lymph nodes infiltrated by neoplasm. Posteriorly the neoplasm is attached by fibrous adhesions to the second, third and fourth ribs and so firmly at the root of the second and third that portions of these ribs were removed in order to facilitate removal of the neoplasm. Medially it is attached to the first, second, third, and fourth dorsal vertebrae, again by firm fibrous adhesions. These vertebral bodies were removed with the tumor and, although the tumor was perfectly encapsulated in other areas, it appears to have invaded the spinal canal at the level of the second and third spinal foramina, extending along

the spinal canal for a distance of about 5 centimeters and forming a mass within the canal approximately 1.5 by 1 centimeter in diameter which somewhat compresses the cord, although it does not appear to have infiltrated it. On cut section of the tumor the cut surface is a dull white in color and is moderately firm. There is a medial area which appears somewhat whorled is firm in consistency and is a grayish-white in color." Weight 180 grams.

Microscopic examination revealed many connective tissue fibers showing whorled areas, numerous scattered ganglion cells, areas of calcification. The portion which invaded the spinal canal has a similar appearance. The nodules on the superior surface of the tumor are similar to the neoplasm, with no evidence that they arose in lymph nodes. Diagnosis, ganglionated neurofibroma.

This case appears to have been a rather rapidly growing ganglioneuroma of the dumb-bell type causing paralysis and then death from spinal cord pressure.

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PILONIDAL CYST

Analysis of 100 Consecutive Cases Emphasizing Treatment by Radical Excision Primary Closure and Penicillin Therapy

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IT is the purpose of this paper to present a series of 100 consecutive cases of patients with pilonidal cyst (sacrococcygeal cyst teratoma U S Navy nomenclature) operated upon by the author between January 15 1945 and July 30 1945. A new previously unreported method of treatment has been used with results that are believed to be unusual.

Eighty-seven of these patients were operated upon by a technique of radical dissection and primary closure to be described and the plentiful use of intramuscular penicillin therapy. In 75 cases, healing occurred *per primam* by the 7th postoperative day. The series includes 34 patients with recurrences who had previously been operated upon elsewhere and 66 patients who had not been operated upon prior to admission to this proctology service. Of this latter subgroup which proved most amenable to radical excision and primary closure, in 60 cases out of 66 or 90.9 per cent healing was firm by the 7th postoperative day.

The technique employed consists of four principal features:

1. Careful preoperative preparation and the routine use of preoperative and postoperative penicillin therapy.

2. Excision of a minimum strip of skin sufficient only to include the ostia of the cyst undermining of the skin, removal of the cyst *en bloc* and the radical excision of the surrounding fat thus exposing the sacrococcygeal fascia and the gluteal fascia bilaterally to assure removal of all cystic tissue.

3. Accurate reapposition of the skin and use of wire through-and-through sutures in-

serted to the outer limits of the wound and underneath the sacrococcygeal fascia. The latter sutures are twisted over rolled gauze dressings and sponge rubber thoroughly to obliterate dead space.

4. Avoidance of the use of any drain or permanent suture in the wound and the removal of all sutures on the 7th postoperative day leaving no foreign body in the wound, thus allowing for a minimum of scar tissue and the restoration of the normal intergluteal fold, without skin tension.

For the sake of presentation and review of cases, the series is divided into three subgroups, the criterion for which was, on admission and at operation the feasibility of primary closure in each case as determined by the condition of the skin overlying the cyst. That is, whether it was intact except for the embryologic ostia (Subgroup 1) scarred by previous operative procedures and containing artificial ostia but not unduly sacrificed (Subgroup 2) or markedly depleted, scarred, and stretched by previous block excision (Subgroup 3).

In Subgroup 1 consisting of all the patients (66) who had not been previously operated upon and who were treated by primary closure healing *per primam* occurred in 60 cases, or 90.9 per cent. In Subgroup 2 consisting of 21 patients who though previously operated upon appeared amenable to primary closure successful primary healing was obtained in 15 cases or 71 per cent. Subgroup 3 consisted of 13 patients who had been previously operated upon elsewhere two or more times. In these patients primary closure was not attempted because of the marked loss of skin and scarring present. Partial closure was carried out, as will be described in an attempt to cut down the disability time to a minimum.

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Fig. 1



Fig. 2



Fig. 3

The surgical treatment of pilonidal disease by primary closure has always presented well known problems the most important of which are infection which frequently nullifies the results alter the best of surgical techniques and the mechanical problem of closure of the wound without tension after thorough excision of the cyst and obliteration of the dead space. The sacrococcygeal area is readily contaminated before and after surgery because of the proximity of the anus and the tendency for the skin to be moist by perspiration. The skin over the sacrococcygeal area is readily traumatized and is stretched in sitting. These factors make any postoperative wound vulnerable long after healing has taken place (27) and make it imperative that sound healing be obtained by complete obliteration of dead space by the avoidance of the use of permanent sutures which act as foreign bodies and by use of a technique which does not sacrifice the vitally needed skin overlying this area.

The needless sacrifice of skin over this area attendant upon block dissections which include the skin and its ultimate replacement in healing by inelastic scar are at least as great a cause of recurrence due to faulty healing as is the failure to obliterate dead space (22, 28).

It is an unfortunate fact that when elliptical incisions are made on either side of the intergluteal fold the maximum loss of skin occurs where it is most needed in the primary closure of the wound—in the widest diameter overlying the glutea. When primary closures are attempted after elliptical excision of the skin a flattening of the intergluteal fold results—producing a painful scar that is constantly stretched and traumatized (27) when the patient assumes the sitting position.

The technique herein presented deals with the problem of infection by adequate pre-



Fig. 4



Fig. 5



Fig 6

operative preparation atraumatic surgery and the unstinting use of penicillin therapy. The second problem that of closing dead space avoiding the loss of skin and maintaining the normal intergluteal fold is met by the following expedients:

1. The avoidance of the use of permanent sutures in the wound that may later set up foreign body reaction.

2. The closure of the dead space, accomplished by the use of multiple, deeply placed wire through-and-through sutures that encompass the wound and include the sacrococcygeal fascia. These are later tied over gauze rolls and sponge rubber to compress the wound and reappose the skin and subcutaneous tissues to the sacrococcygeal fascia. This dressing is then reinforced with an adhesive tape dressing so applied as further to facilitate the reapposition of skin and fascia and to remove any tension from the sutures.

3. The scrupulous avoidance of needless sacrifice of uninvolved skin by removing in the initial incisions, only a thin strip of skin sufficient to include the ostia of the cyst whether embryologic or artificial and any scar tissue present, resulting from previous incision and drainage or from more extensive procedures.

PREOPERATIVE PREPARATION

All patients, on admission are routinely given sitz baths three times daily and instructed to cleanse the sacral area thoroughly with soap and water. Cevitamie acid 100 milligrams daily is given by mouth. All patients

are given penicillin therapy from the day of admission—whether the condition of the cyst is quiescent infected with or without draining sinuses or abscessed. Penicillin 15,000 units, is given intramuscularly every 3 hours.

When abscesses exist or inadequately draining sinuses are present, preliminary incision and drainage are done with local 1 per cent procaine anesthesia. The incision for drainage is linear and made as close to the midline as possible to obviate later difficulties in securing intact skin flaps when complete excision of the cyst is done. Hair and other loose detritus must be removed to assure cessation of infection and drainage (128). No patient is ready for radical excision procedure until infection and induration have been thoroughly resolved by sitz baths adequate drainage penicillin and daily sterile dressings.

The night before surgery the sacrococcygeal area is carefully shaved. The patient receives two enemas one of warm water and one of glycerine and water. A third warm water enema is given in the morning 2 hours before operation. Morphine sulfate, $\frac{1}{4}$ grain, and scopolamine $\frac{1}{64}$ are administered 1 hour prior to operation. At the time of operation the operative field is again carefully scrubbed with sterile green soap and water.

OPERATIVE PROCEDURE

The technique for this primary closure emphasizes the following points:

1. Spinal anesthesia (4) is used.
2. Excision of but a narrow strip of skin is done in the midline often no wider than $\frac{1}{4}$

Fig 7

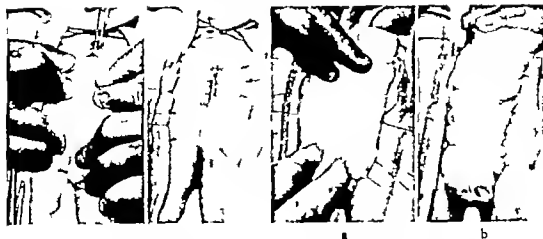


Fig 8.

Fig 9.

Fig 10.

b

inch to include the ostia of the cyst and scars from previous incision and drainage procedures (Fig 1). The skin is cleanly and accurately incised at right angles to facilitate meticulous approximation in the closure.

3. Block dissection of the cyst is accomplished down to and exposing the sacrococcygeal fascia in its entirety (Fig 2). The skin edges are then undermined with the scalpel blade partially on the flat, the lateral fatty tissue divided and the subcutaneous tissue and a small amount of fat left attached to the flaps (Fig 3). The triangular strip of fatty tissue remaining on the gluteal fascia is then removed with scissors (Fig 4) thereby leaving the sacrococcygeal fascia and the gluteal fascia denuded bilaterally (Fig 5). Care is exercised throughout to avoid traumatizing the skin flaps or other tissues.

4. Thorough hemostasis is accomplished by the use of plain No. 000 catgut transfexion ligatures, electrocoagulation wherever possible, and frequent copious irrigations of the wound with hot sterile saline solution.

5. Débridement of the wound is then done by carefully excising all loose tags of fat or fascia and floating out small clots and fat globules with further irrigations of hot saline solution.

6. A sufficient number (usually 8 or 10) No. 30 stainless steel through and through sutures are placed $\frac{1}{2}$ inch apart through the skin under the gluteal fascia and under the sacrococcygeal fascia (Fig 6a and 6b) to be used to exert moderate pressure in closing dead space. Several may be required close

together at the distal end of the wound to assure closure of dead space here—especially if the skin incision required extension beyond the tip of the coccyx. The lowermost deep suture may pass through the bone itself if necessary to anchor the suture firmly in the depth of the wound.

7. The skin is then accurately reapposed with No. 30 stainless steel wire vertical mattress sutures (Fig 7a and 7b).

8. After closure of the skin a thumb forceps is inserted through the upper end of the wound and any serum or blood is evacuated by exerting moderate pressure with gauze pads from below upward (Fig 8). At this point following accurate reapposition of the wound the skin and its subcutaneous tissues will remain apposed to the sacrococcygeal fascia by atmospheric pressure alone restoring the intergluteal fold (Fig 9). If however a slight tendency to sucking occurs it does not indicate that tension is present and apposition will nonetheless be accomplished when the lateral wires are secured over the gauze dressing.

9. Loosely rolled gauze dressings are then carefully placed next to the suture line and over the wound to keep the tissues apposed to the sacrococcygeal fascia. A section of sponge rubber 1 by 2 by 4 inches is incorporated into the dressing and some manual pressure is maintained throughout. The through and through wires previously placed are then twisted over the whole dressing, beginning from below upward (Fig 10a and 10b). Care must be exercised to avoid tightening the



Fig.

wires too much. The elasticity of the dressing itself maintains moderate pressure.

10. Adhesive tape is then applied to the area in such a manner as further to relieve any tendency to tension on the sutures when the patient moves about in bed postoperatively (Fig. 11).

11. All sutures are removed on the 7th postoperative day, leaving no permanent foreign body in the wound (Fig. 12).

POSTOPERATIVE CARE

Following surgery, the patients are kept at absolute bed rest on the abdomen or on either side for a period of 7 days. The penicillin in doses of 15,000 units every 3 hours intramuscularly is continued until the 8th postoperative day. The ascorbic acid is likewise continued at 100 milligrams daily by mouth. A low residue, high vitamin diet is prescribed

and evacuation of the bowel is discouraged until after the sutures are removed. These patients get along surprisingly well and in only 2 instances, when diarrhea was present, was evacuation necessary before 7 days. Fortunately, infection did not develop in either case. There was no appreciable postoperative pain and no necessity for morphine, though $1\frac{1}{2}$ grains of nembutal was prescribed for nocturnal restlessness.

After the 7th day when the sutures have been removed, an enema is given and the patient is allowed toilet and shower privileges. They are cautioned against sitting or undue exertion for a few days to avoid putting stress on the recently healed wound.

In treating the type of case described in Subgroup 3, that is, patients with recurrences who had been operated upon two or more times elsewhere and in whom there was an excessive amount of scarring and loss of skin as evidenced by the flattening of the intergluteal folds, the primary closure described was not considered feasible nor was it intended for those large postoperative scar defects.

It will be agreed that the surgical problem encountered in such cases was something more than that of the treatment of pilonidal cyst alone. Even after the most conservative treatment at operation when the scar tissue was excised, these wounds gaped widely as might be expected, so that some form of partial closure was necessary to cover the defect if the prolonged healing time and wide delicate scars associated with healing by secondary intention (27) were to be avoided.



Fig. 12.

The preoperative care and the operative procedure followed were identical with those described for the primary closure operation except that reapposition of the lateral skin flaps after excision of the scar tissue and granulation tissue pockets was not possible nor contemplated.

Accordingly the lateral skin flaps were freed and an adaptation of the horizontal mattress suture suggested by Captain Harry R. Huston M.C. U.S.N.R. Chief of Surgical Services at this hospital was used, effecting the partial closure of the defects by the expedient of securing the skin edges to the sacrococcygeal fascia. This was done by the use of 4 to 6 horizontal, figure of eight, No. 30 stainless steel wire mattress sutures that included the skin edges and the sacrococcygeal fascia.

Sections of small gauge rubber tubing were threaded on the wire sutures where they perforated the skin edges. The skin was then drawn down to the sacrococcygeal fascia with as little tension as possible and a greater or lesser gap left between the skin edges according to the amount of skin available to cover the defect. In 6 of these cases, the skin could be brought together with only a very narrow $\frac{1}{4}$ inch defect. Accurate reapposition of the skin edges was not possible with this method, nor was it sought, because of the drainage required after excision of these scar tissue cavities.

The sutures were removed on the 7th postoperative day by which time some pressure necrosis had occurred under the rubber of each suture. The skin remained attached to the fascia, however, and the center of the wounds healed by granulation tissue. These patients were kept at bed rest. Penicillin therapy 15,000 units every 3 hours, was continued for 10 to 12 days after operation. The wounds were irrigated daily with azochloramide solution 1:5000 and probed daily with a sterile cotton applicator to break down pocketing. A small dressing was then inserted and saturated with a solution containing 33 milligrams of tyrothricin per 100 cubic centimeters of sterile distilled water.

REVIEW OF CASES

Subgroup 1 In the 66 patients (Subgroup 1) who had not been previously operated upon

20 were free of gross infection at the time of admission although all patients gave a history of previous exacerbations of swelling and tenderness over the cyst area. In 46 cases infection was present upon admission. Seventeen of these 46 patients had abscesses which required preliminary incision and drainage prior to operation for radical excision. In 15 other cases of infection acute inflammation was present on admission but there was adequate drainage through the embryologic ostia. The inflammation subsided after the patient received hot sitz baths and penicillin therapy. In the remaining 14 cases infection was present as evidenced by purulent secretion expressible from the ostia but there was no surrounding inflammation or induration. In these latter cases the infection also responded to sitz baths and penicillin therapy.

Incision and drainage of the abscesses were carried out with 1 per cent procaine solution local anesthesia. An average of 4 hospital days elapsed before radical operation was performed in these cases.

As might be expected the locations of the secondary ostia and many of the scars from previous incision and drainage procedures were not conveniently located in the midline. Many of the skin incisions later made at operation for radical removal were necessarily somewhat curved or irregular in shape in order to remove both scars and sinus openings in the sections of skin removed. The narrow strip of thin skin in the very center of the intergluteal fold was always included in the excision however because it is here that the embryologic ostia are situated. In several instances the secondary ostia of these cysts were located an inch and a half or more to either side of the midline and directly lateral to embryologic ostia in the intergluteal fold. Vertical curved incisions that would circumvent both of these openings would necessarily include an excessive amount of normal skin. In such cases, the usual strip of skin was removed in the midline and small horizontal elliptical incisions were made on either side of the scarred secondary ostia. These openings were thus buttonholed the ostia with the small elliptical area of skin attached being removed with the cyst as it was dissected *en bloc*.

In 4 instances sinuses extended to the perianal area where the tracts were palpable in the fat of the ischioanal fossa. One sinus tract traversed the right ischioanal space about 2 centimeters lateral to the anal verge and opened in the perineum to the right of the urethra. There was one inverted Y shaped sinus tract, the two limbs of which flanked the anus where an ostium was present overlying each ischioanal fossa. The tracts in all cases were readily palpable.

In the differential diagnosis from fistula in ano (2 12 15) the tracts were palpable and found not to curve toward the anal canal but were traced directly to the cysts. Probes were readily introduced to trace the course of the tracts. Careful proctoscopic examinations were done and the crypts were explored with a crypt hook for possible primary ostia of fistula in ano.

At operation these sinus tracts were incised over a grooved director and traced to the cyst. They were then completely excised and the wounds closed as a continuation of the main cyst wound. The deep wire sutures traversed the depths of the wounds in the fat of the ischioanal fossae. The skin was closed in the usual manner as a continuation of the main cyst wound and the tension sutures tied over rolled gauze dressings.

In 60 of these cases the wounds were cleanly healed on the 7th postoperative day without pocketing, hematoma, or other complication. Failure in the remaining 6 cases occurred as follows: Three patients developed some pressure necrosis attendant upon the application of excessive pressure when the wires over the dressing were tightened. These patients complained of pain of a throbbing character which is indicative of this mistake. Areas of pressure necrosis $2\frac{1}{2}$ centimeters in diameter occurred on each side of the wounds where the compression sutures entered the skin. These required 15 17 and 18 days to heal. In 1 case a hematoma developed beneath the scar (2 22) making it necessary to open the overlying skin. In this case healing was complete in 30 days. In 2 cases frank abscesses beneath the skin developed which required opening of the wounds. These were probed with cotton applicators to break down pocketing irrigated

with sterile saline solution and packed with small gauze dressings containing a solution of tyrothricin, 33 milligrams per 100 cubic centimeters of sterile distilled water. The intramuscular penicillin was continued in all of these cases for 7 additional days in the first 3 and 15 days in the other 3. The tyrothricin solution was added to the dressing every 3 hours and dressings changed daily. In the abscessed patients the wounds were not allowed to gape but the skin edges were kept toward the midline by the use of large adhesive tape bridges. The dressings were applied under the bridges. The average healing time in these 66 cases was 8 7 days.

Subgroup 2 The 21 patients with recurrent pilonidal cyst comprising Subgroup 2 had been operated upon elsewhere prior to their admission and infection was present in all cases though there were no abscesses. Thirteen of them had been operated upon two or more times (In 2 instances, 3 operations) but it was impossible to determine what method or methods had been used. The common denominator in this subgroup that made them appear to be amenable to primary closure was the presence of seemingly adequate healthy skin which had not been unduly sacrificed in the previous surgical procedures.

At operation in 3 of the patients who had been operated upon once grossly appearing cystic tissue was present. All of the remaining cases were found to be recurrent because of faulty healing and the presence of chronic granulation tissue pockets (22 28) and infected scar tissue.

All of these patients were treated as in group 1 by primary closure after radical excision of scar tissue and granulation tissue pockets. In 15 of these 21 cases healing *per primam* occurred in 7 days. There were 6 failures, the longest healing time of which was 40 days and the shortest 20 days. In 1 of these 6 cases there had been severe infection upon admission considerable pocketing and scarring and 3 draining ostia 2 centimeters from the right of the midline. In this case dead space was not completely dealt with at operation or the lateral skin flaps were too long. There was pocketing under the skin when the sutures were removed and bloody purulent material

was present. The wound was partially laid open and redressed daily. A sterile dressing was placed in the wound and saturated with tyrothricin solution 33 milligrams per 100 cubic centimeters of distilled water. The tyrothricin was added to the dressing every 3 hours. Large adhesive tape bridges prevented the wound from gaping and the dressings were applied under the bridges. In 2 cases small hematomas developed which were evacuated on the 7th day when the stitches were removed. Fortunately, they occupied only a portion of the wound and the recently healed incisions overlying the hematomas were only partially separated. Here again tyrothricin was used locally in the manner described. In the remaining 3 patients although firm healing took place otherwise small unhealed areas of granulations developed where the skin was reaposed. Until these areas were thoroughly dry the wounds could not be classified as healed.

In these cases Carnoy's solution was applied and curettement of the excess granulations carried out after which a small pledget of tyrothricin soaked cotton or gauze was applied and secured by adhesive tape. Covering the wet dressings with waxed paper prevented rapid evaporation in the dressing. The first 3 failures were kept on intramuscular penicillin for 10 additional days making a total of 20 days per case. The latter 3 patients did not require additional penicillin therapy. The average healing time in this subgroup was 12.6 days.

Subgroup 3 These 13 patients admitted with recurrences of pilonidal cyst had all been operated upon elsewhere two or more times. Upon admission each of these patients was found to have persistent sinuses marked scarring and an excessive amount of skin loss over the sacrococcygeal area from previous operative procedures.

At operation the sinus tracts were found to be granulation tissue pockets due to faulty healing rather than to residual cystic tissue. In appraising these patients for further surgery primary closure was not considered feasible. The preoperative care and the operative procedure used were for the most part identical with that described for primary clo-

sure including removal of all scar tissue and the lateral triangles of fatty tissue overlying the glutea. A partial closure was then done by the use of horizontal mattress sutures through the skin and sacrococcygeal fascia. The sutures were removed on the 7th postoperative day and the wounds were irrigated with 1/5000 azochloramide solution. Daily dressings were done and frequent explorations of the wounds were made with sterile cotton applicators to prevent bridging and pocketing. Slowly healing granulations were treated with Carnoy's solution and curettement. Five of the later patients were treated locally by dressings saturated in tyrothricin solution 33 milligrams per 100 cubic centimeters of sterile distilled water. Penicillin in 15,000 unit doses, every 3 hours intramuscularly was given without interruption for an average of 18 days. The shortest period of time of healing and of penicillin therapy was 12 days (5 cases) and the longest period was 45 days (2 cases). The average healing time was 26.5 days. This is not the method of choice for the treatment of patients with pilonidal cysts not previously operated upon but it is a necessary and valuable expedient in some cases in the handling of some recurrences in which primary closure cannot be accomplished.

DISCUSSION AND CONCLUSIONS

David, Gage, Kooistra, and others have long advocated primary closure in dealing with pilonidal cyst before the advent of penicillin and tyrothricin and have presented substantiating evidence favoring the rapid healing and smaller scars attendant upon this method of treatment. Brezin pointed out that such scars are more resistant to trauma.

Tendler, Kleckner, MacFee, Theis, and Rusher and others are agreed that complete excision is essential for cure and that open pack methods of treatment result in prolonged healing and wide delicate scars. That primary skin closures prevent subcutaneous drainage and cause subcutaneous hematomas or serum collections which become infected and result in sinus formation (2, 22, 28) was not borne out by this series of cases. These complications are largely obviated in the described technique by transfixion ligature of all bleed-

ing points penicillin therapy and the use of the through-and-through wires for the compression dressing. It is well to point out, however, that in cases in which there is failure of primary healing it is most likely to be due to a hematoma which is readily apparent and palpable on the 7th postoperative day when the sutures are removed.

Magrath believes that the present appellation of pilonidal or sacrococcygeal cyst or sinus is unsatisfactory and that the present statistical method of reporting end results of operative procedures is misleading. He further states that under the present system of all-inclusiveness, one series of cases may present such extraordinary results that a surgeon may attempt the same type of operation with an entirely different type of involvement and thereby have discouraging results.

Accordingly the author has herein reported a consecutive series of cases and has attempted to lay down the criteria used in a given case in electing to use a technique of primary closure or a method of partial closure followed by tyrothricin dressings. These same criteria and techniques have been used by the writer in operating upon an additional 138 consecutive patients for pilonidal cyst since the completion of the series herein reported and have been found to be applicable in treating pilonidal disease irrespective of the extent of involvement encountered.

Fourteen months have elapsed since the beginning of this series, during which time all of these 100 patients have been followed carefully by physical examinations or through periodic questionnaires, stressing pain, soreness, drainage, swelling or any disability.

The results to date are as follows: there were 5 patients with recurrences in this series—3 of whom have been reoperated upon elsewhere and 2 who will undoubtedly require further surgery. In checking back into the operative records and case histories of these recurrences, it was found that 4 of them were in the Subgroup 3 and 1 was in the Subgroup 2. All 5 patients had been operated upon prior to the operation done by the author. In the early part of this series certain significant errors and omissions of technique and medication were made which may well account for

these failures. It was found that in 2 of these early Subgroup 3 cases in which the previous operative scars had been seemingly adequately excised and the skin undermined and secured to the fascia in the usual manner, the through-and-through sutures had been omitted and tyrothricin had not been available in the postoperative treatment. The other 2 recurrences in group 3 were, it is believed, the result of faulty surgical judgment. That is, in these 1 early cases, the lower third only, of the previous operative scars had been excised as it was in this area alone that recurrence had occurred and it seemed to be an adequate procedure at the time. The edges of the wounds were secured to the sacrococcygeal fascia after the skin was undermined in the usual manner. One patient had received local tyrothricin after operation and 1 had not. In any event, this pseudoconservatism in excising only a portion of such a recurrent cyst scar is to be condemned. The other recurrence was in Subgroup 2. The patient had been operated upon twice before and the author made an ill-advised effort to do a primary closure. This failed on the 7th postoperative day as a result of hematoma and the wound required opening and packing with arochloramide 1/5000 dressings. Here again tyrothricin had not yet been made available.

It has been observed and repeatedly recorded (21, 27) that recurrences are due occasionally to inadequate excision of the sinus but usually to infected granulation tissue lined pockets in the depth of the wound. It would seem from this fact and from a study of these recurrences, that aside from the errors of omission in failing to obliterate dead space, the continuous use of tyrothricin solution topically is an indispensable factor in combating infection in these open wounds and in thereby promoting sound healing.

Recurrence has not taken place in any of the 75 patients in whom primary closure was accomplished nor in those patients in whom partial closure with through-and-through wires and tyrothricin dressings was used, although all of these men returned to active and oftentimes, to strenuous duty in the navy and at this time to various active pursuits in civilian life.

Incisions done for drainage of pilonidal cysts preliminary to radical excision or even as a palliative measure for abscess should be made in a position giving due thought to the preservation of the skin for closure in later operation for total removal namely in the midline in the intergluteal fold whenever possible. In this manner, the artificial production of eccentrically situated ostia and sinuses can be largely circumvented and later operation simplified.

Surprisingly enough tender or painful scars have not been an outstanding sequela of this method of treatment although the fat in the intergluteal fold was almost completely excised and the wounds closed as described. In the author's experience tender postoperative scars frequently result from other factors than the lack of a fat pad over the sacrum. Tender or painful scars often occur when the skin and scar over the intergluteal fold are under tension as in the cases following elliptical incisions for block dissection and primary closure. Pain is frequently complained of in the thick, broad, adherent scars resulting from block dissection and open pack methods of treatment or in cases in which deep permanent sutures have been used. Fourteen of the 75 patients treated by primary closure reported various degrees of tightness in the operative scar upon bending over as to tie a shoe lace or discomfort upon prolonged sitting following a train ride but in no case was it an especially noteworthy complaint and these patients were highly satisfied with the results obtained. This tightness was noticeable to more or less extent depending upon the type of work done by the individual and occurred periodically for an average of 8 weeks after operation. The other 61 patients in this category reported complete freedom from any local postoperative tenderness or discomfort after initial healing had taken place. As might be expected more persistently tender scars occurred in the Subgroup 3 patients in whom the wounds had been of necessity left partially open and healed in by granulation tissue. Even here however there were individual variations in tenderness reported that were no more or less than would be expected following any secondarily healed wound in this area.

It is believed that the method of treatment herein presented largely overcomes the causes of recurrence by the use respectively of radical excisions to obviate sinus remnants and a maximum of penicillin therapy plus obliteration of dead space to prevent granulation tissue lined pockets.

In the author's opinion primary closure is the method of choice in the treatment of pilonidal cyst. The procedure is both practicable and desirable in the vast majority of cases and is adaptable even to some cases of recurrence following other procedures. It eliminates the protracted postoperative treatment and disability attendant upon open methods and circumvents the open wound and attendant infection which is such an important factor in the production of the infected granulation tissue lined sinuses of recurrences. The method results in the restoration of a normal intergluteal contour with a minimum of scar tissue that is resistant to trauma.

SUMMARY

1. A series of 100 consecutive patients operated upon for pilonidal cyst has been analyzed.
2. A technique that stresses sparing of the skin, radical excision of all cystic tissue and adjacent fat tissue, routine use of penicillin therapy and a type of primary closure that eliminates dead space was used for all patients who had not been previously operated upon (66 cases) primary healing being obtained in 90.9 per cent.
3. The same technique was used in recurrences in which the skin had not been unduly sacrificed by previous surgical procedures (21 cases) primary healing being obtained in 71 per cent.
4. Partial closure was used in treating recurrences in which the skin had been too widely sacrificed by previous operative procedures to permit primary closure (13 cases) average healing time in these was 26.5 days.

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THE LATERAL ABERRANT THYROID

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THE subject of the diagnosis and handling of lateral aberrant thyroid tissue is of importance for many reasons.

The existence of tumors arising in such tissue is apparently often not appreciated. They are all potentially malignant. Patients with such tumors respond well when treated by radical operation and intensive radiation. Aberrant thyroid tissue occurs in different types of tumors large and discrete as multiple gland like masses and occurring at the same time as they not infrequently do in the thyroid gland and along the internal jugular veins the tumor in this gland is wrongly considered the primary focus of malignant disease, the aberrant thyroid masses along the internal jugular veins metastases and the out come considered hopeless.

In the course of embryonic development thyroid tissue which persists outside of the thyroid gland proper is termed aberrant thyroid tissue. Aberrant thyroid tissue may be of lateral, median or ectopic origin. Lateral aberrant thyroid tissue finds its origin in the ultimobranchial bodies. At the beginning of the seventh embryonic week each ultimobranchial body united with the adjacent fourth parathyroid is set free from the pharynx. During this time growth of the thyroid brings its two lobes into contact with the ultimobranchial bodies. Each of the latter then loses its cavity and becomes incorporated into the thyroid gland. Occasionally the ultimobranchial bodies undergo conversion into thyroid tissue. This conversion is attributed to the dominating influence of a thyroid environment on a plastic, implanted tissue. To this degree the ultimobranchial bodies are lateral aberrant thyroid primordia (1) (Fig 1)

INCIDENCE

The presence of lateral aberrant thyroid tumors is not a common clinical entity. A study at this clinic revealed 30 patients with lateral aberrant thyroid tumors encountered prior to January 1939 (2). Since that date 17 addi-

tional patients have been treated up to and including June 1945. During this period 25,000 patients were treated for various types of goiter. Thus approximately 1 patient with lateral aberrant thyroid was seen for every 500 patients with goiter.

An analysis of the 30 cases seen prior to January 1939 indicates that these tumors may occur in patients at any age but usually under 40 years. They occurred five times more frequently in women than in men. Histopathologic diagnosis in all cases was papillary cystadenoma showing little differentiation into adult thyroid structure. All were considered either potentially or definitely malignant. As such, the patients were treated by radical operation followed by radiation therapy.

The 17 most recent cases studied at the clinic since January 1939 are presented in Table I.

CLINICAL PICTURE

Tumors arising in lateral aberrant thyroid tissue produce no characteristic symptoms. The presence of a swelling in the neck is noticed by the patient or found by the examining physician. Most commonly a history is given of a swelling symptomless at onset, which gradually increases in size over a period of months or years. The growth is not only gradual but may not alter its size, shape or consistency over a period of years. Occasionally, after a long period of no growth, a recent rapid increase in size may be noted and cause the patient to seek advice.

These tumors are usually multiple, producing movable gland like masses which are located along the neck in front of the sternomastoid beside the internal jugular vein (Fig 2b). At times a long chain of nodules gland like in character can be palpated from the mastoid process and at times below the clavicle along the sternomastoid muscle on one or both sides (Fig 2a). Occasionally a single deep seated tumor of the neck, firm in character, not unlike a carotid body tumor, will prove to be a single lateral aberrant thyroid (Fig 2c).

TABLE I. — SUMMARY OF CASES STUDIED SINCE JANUARY 1919

Cases, age, sex	History	Duration of symptoms	Side involved	Date of operation	Operation performed	Pathologic diagnosis	Latest follow up date
14 F	Mass left side of neck	2 1/2 yrs	Left	7-39	Left total hemithyroidectomy plus thyroid isthmus radical neck dissection	Papillary cystadenoma, metastasis to lymph nodes	11-23-43 No recurrence
15 F	Previous thyroidectomy 1931. Recurrence of mass on neck when 6 mos	7 yrs	Left	8-39	Radical left lateral aberrant thyroid tumor, left thyroid remnant, lymph nodes, and small nodes under skin scar	Recurrent papillary adenocarcinoma	6-17-44 No recurrence
16 F	Enlarged thyroid; subtotal thyroidectomy Jan 1939	5 yrs	Right	9-3-39 (4 mos after thyroidectomy)	Right radical neck dissection	Papillary cystadenoma with blood vessel invasion	1941 No recurrence
17 M	Thyroid trouble	7 yrs	Left	10-15-39	Left total hemithyroidectomy excision aberrant thyroid tumor, left radical neck dissection	Papillary cystadenoma with metastasis to one lymph node and local muscular invasion	5-17-44 No recurrence
18 F	Swelling right side of neck	7 yr	Right	4-3-40	Right total hemithyroidectomy excision aberrant thyroid, radical neck dissection	Papillary adenocarcinoma, metastasis to 3 of lymph nodes	Recurrence 3-12-44, mass up to 10-1-44; recurrent nodular goiter March 1945
19 F	Mass left side of neck	7 yr	Left	12-4	Left total hemithyroidectomy excision aberrant thyroid tumor, left radical neck dissection	Papillary adenocarcinoma with blood vessel invasion	10-21-43 No recurrence
20 F	Visible node right side of neck	7 yr	Right	6-6-41	Right total hemithyroidectomy right radical neck dissection	Papillary cystadenoma, metastasis to lymph nodes with blood vessel invasion	9-26-43 No recurrence
21 M	Aberrant thyroid found during routine examination	?	Right	6-9-43	Right total hemithyroidectomy right radical neck dissection	Papillary adenocarcinoma	7-1-44 No recurrence
22 F	Nodule left side of neck.opsy elsewhere showed papillary cystadenoma	6 yrs	Left	7-27-43	Left total hemithyroidectomy left radical neck dissection	Papillary cystadenoma with metastasis to lymph nodes	10-1-44 No recurrence
23 M	Swelling left side of neck	10-15	Left	10-43	Left total hemithyroidectomy left radical neck dissection	Papillary adenocarcinoma with blood vessel metastasis	5-17-44 No recurrence
24 F	Nodule in neck	7 yr	Right	4-16-43	Right total hemithyroidectomy excision aberrant thyroid tumor, right radical neck dissection	Papillary cystadenoma with blood vessel invasion and multiple metastases	3-17-44 No recurrence
25 F	Gravidity enlarging mass in right side of neck	10 yrs	Right	8-23-43	Right total hemithyroidectomy excision of aberrant thyroid, right radical neck dissection	Papillary cystadenoma with involvement of thyroid, metastasis to 4 of 7 lymph nodes	6-2-44 No recurrence
26 M	Neck swelling, biopsy elsewhere 1933 showed aberrant thyroid tumor. Biopsy again 1943 showed papillary adenocarcinoma	7 yr	Right and left	9-29-43	Left total hemithyroidectomy left radical neck dissection 9-29-43; right radical neck dissection 10-15-43	Papillary adenocarcinoma with metastasis to lymph nodes	10-26-44 No recurrence
27 F	Swelling right side of neck	7 yr	Right	10-6-43	Right total hemithyroidectomy radical neck dissection	Papillary adenocarcinoma with loci of carcinoma simplex	5-17-44 No recurrence
28 M	Swelling left side of neck. Biopsy 5-8-43 showed papillary adenocarcinoma	7 yr	Left	5-19-43	Left total hemithyroidectomy left radical neck dissection	Papillary adenocarcinoma, metastasis to 4 of 7 lymph nodes	Being followed at present, no report for report
29 M	Mass on left side of neck	7 yr	Left	2-28-43	Left total hemithyroidectomy left radical neck dissection	Papillary cystadenoma	Being followed at present, no report for report
30 F	Mass on neck. Biopsy elsewhere May 1943 showed papillary adenocarcinoma	1 1/2 yrs	Left	6-11-43	Left total hemithyroidectomy left radical neck dissection	Papillary adenocarcinoma	Being followed at present, no report for report

All patients received nonoperative treatment.

DIFFERENTIAL DIAGNOSIS

The clinical diagnosis of tumors originating in lateral aberrant thyroid tissue is often not made unless one recalls that any laterally located mass may be a lateral aberrant thyroid tumor. In our series before 1939 a correct diagnosis was made preoperatively in 16 per cent of the cases with a tentative diagnosis of lateral aberrant thyroid tumor. In an additional 33 per cent. As our knowledge and experience with these tumors have increased our ability to distinguish them preoperatively has likewise increased. In our second series of 17 cases the correct diagnosis was made preoperatively in 80 per cent of these patients.

Aberrant thyroid tumors must be distinguished from all the simple tumors of the neck. By dividing these tumors into median line tumors and lateral neck tumors a simple and practical classification is made available (Fig 3).

Median line tumors are for practical purposes almost all limited to the thyroid gland. They are the tumors that are limited to the descent of the thyroid. These are the undescended thyroids from their point of origin at the base of the tongue, the sublingual thyroids, the thyroglossal cysts, the pyramidal lobes and the adenomas in the isthmus. The single lateral tumors and sinuses of the neck are the branchial sinuses, branchial cysts, carotid body tumors and neurofibromas. The mul-

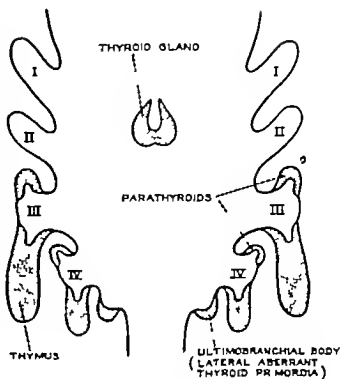


Fig 1

tiples tumors are the aberrant thyroids, tuberculous glands, inflammatory, nonspecific glands, the various other inflammatory types, and metastatic and nonmetastatic neoplasms in various organs of glands. In this group of multiple tumors occurs the greatest difficulty in distinguishing tumors of lateral aberrant thyroid origin. Table II will assist in the differential diagnosis of these tumors.

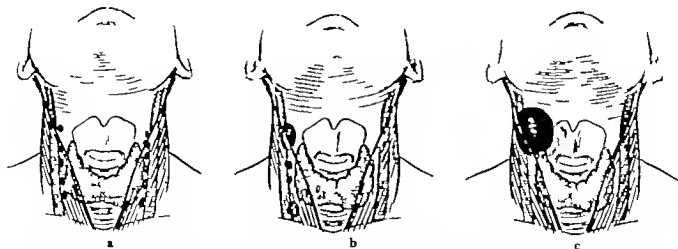


Fig. 2. a, This illustration shows the occurrence of a chain of gland-like bodies, often on both sides, in front of the sternomastoid muscle beside the internal jugular vein in lateral aberrant thyroid. b, Multiple gland-like bodies,

irregular in size, of lateral aberrant thyroid, occurring laterally. c, The occasional occurrence of a single, discrete, good-sized nodule, often not unlike a carotid body tumor is demonstrated.

TABLE II. — DIFFERENTIAL DIAGNOSIS OF MAIN DISEASES CONFUSED WITH TUMORS ARISING IN LATERAL ABERRANT THYROID

Disease	Age	Distribution of lesion	Character of mass	Associated findings	Course	Prognosis
Tuberculosis	Infants and children	Associated with general or local lymphadenopathy	Tender glands, chondros, matted together	Evidence of tuberculous elsewhere occasionally	Chronic	Lymph node containing Langhans' giant cells, tubercles
Lymphosarcoma	Usually over 40	Main group of cervical glands involved	Large mass matted glands not tender	Definite picture of chronic illness	Usually fatal in 1-2 yrs	Lymph node with atypical proliferating lymphoid cells in few reticulae
Hodgkin's	Mainly young adults	Local glandular enlargement, gradually becoming generalized	Marsh, discrete glands not tender	Fever (Pel-Ebstein type) eosinophilia	Chronic with fatal outcome in 1-4 yrs usually	Lymph node with Reed-Sternberg giant cells and eosinophils
Inflammatory glands	Any age	Regional glandular enlargement according to area affected	Enlarged tender glands	Evidence of primary infection; fever leukocytosis	Rapid recovery with treatment	Hypertrophy of lymph node
Metastatic carcinoma	Usually elderly males	Usually or predominantly glandular	Hard, firm glands	Evidence of cancer in thyroid, pharynx, stomach or lung	Gradually downhill and fatal	Metastatic carcinoma
Aberrant thyroid tumors	Usually under 40	Single or multiple masses occurring in chains along lateralized vessels	Movable gland-like masses	May be none	5 to 35 years of disease with adequate treatment	Papillary cystadenoma or papillary adenocarcinoma

PATHOLOGY

Macroscopic inspection of lateral aberrant thyroid tumors frequently reveals a bluish-black discoloration of the tumor tissue. This color results from blood pigment which weeps from the papilliferous elements of the tumor.

The histologic appearance of these tumors is that of a papillary cystadenomatous structure (Fig. 4). Adult thyroid elements are not visualized. This makes it difficult to identify the tissue as of thyroid origin. The macroscopic appearance of this papilliferous tissue is so characteristic and constant, however that whenever a tumor is removed from the

lateral region of the neck and is diagnosed as papillary cystadenoma, it is in all probability a lateral aberrant thyroid and is actually or potentially malignant.

Invasive tendencies are found in many of the papillary cystadenomatous nodules. Some of our cases were definitely adenocarcinoma both in cell structure and in invasive characteristics (Fig. 5). In our classification papillary cystadenoma malignant is a little more differentiated and a little less malignant than the papillary adenocarcinoma. Histologically the tumor is predominantly papillary adenocarcinoma with blood vessel invasion.

The problem often arises as to whether or not these tumors are metastatic glands with the thyroid gland as the primary site of the growth. Several of our patients have shown unilateral involvement of a thyroid lobe with a nodule of papilliferous tissue within the thyroid gland itself. In the majority of instances, however lateral aberrant thyroid nodules have occurred with an entirely normal and uninvolved thyroid gland. When the thyroid gland has been involved, equally good results have followed hemithyroidectomy including the nodule plus the removal of the lateral nodules and radiation as have followed in the cases in which no nodule was present in the thyroid. Papillary

CLASSIFICATION OF SIMPLE NECK TUMORS

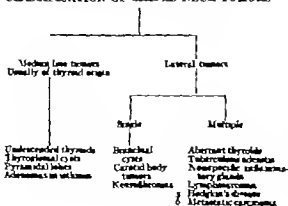


Fig. 3.



Fig. 4. The typical papillary cystadenomatous structure of lateral aberrant thyroid tissue is illustrated.

cystadenomatous structures along and behind the sternomastoid muscle as well as those within the thyroid lobe itself can be explained on embryologic grounds without spread or metastasis in either direction. The lateral aberrant cell masses fuse very early in the embryo with the thyroid of median origin. Since the tumors occur anywhere laterally in the neck or in the thyroid it is probable that the papillary nodules fuse very early in the embryo with the thyroid of median origin. Since the tumors occur anywhere laterally in the neck or in the thyroid it is probable that the papillary nodules fuse very early in the embryo with the thyroid of median origin. Since the tumors occur anywhere laterally in the neck or in the thyroid it is probable that the papillary nodules fuse very early in the embryo with the thyroid of median origin.

TREATMENT

When multiple tumors of the neck are present an early biopsy to determine the nature of the lesion is important in order to undertake proper and adequate treatment, particularly when the microscopic report is papillary adenocarcinoma. A diagnosis of lateral aberrant thyroid nodules demands radical surgical



Fig. 5. Note in this papillary adenocarcinoma arising in lateral aberrant thyroid tissue all types of invasion: blood vessel invasion, perineural invasion, and lymphatic invasion.

treatment followed by intensive postoperative radiation therapy.

When a discrete nodule is found without involvement of the thyroid lobe and without other lateral aberrant thyroid nodules, complete removal may be sufficient. When several nodules are encountered dissection of the neck on that side is indicated. In the presence of invasion characteristics and the diagnosis of papillary adenocarcinoma, radical neck dissection on the side involved should be performed. This dissection includes removal of the sternomastoid muscle, internal jugular

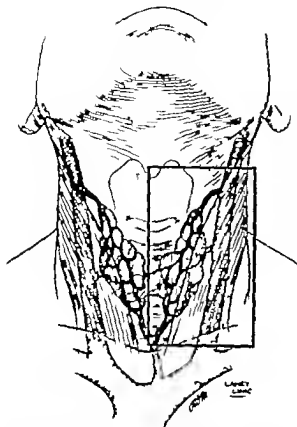


Fig. 6. This illustration diagrammatically shows the block of tissue to be removed in patients with aberrant thyroid tissue containing papillary adenocarcinoma.

Not that this block includes the sternomastoid, the internal jugular vein, all of its tributaries entering the thyroid, all of the lymphatic nodes and all of the thyroid tissue on the side involved.

vein, all lymph nodes and total hemithyroidectomy on that side (Fig. 6)

Postoperative radiation therapy has been employed in all cases in which any criteria of malignancy were demonstrated. A total of 6000 r is applied to the tumor bed over a 22 day period. During the period of treatment serum cholesterol levels are taken. If this level rises to 300 milligrams or more, small doses of thyroid extract are administered.

FOLLOW UP STUDIES

In our series of cases prior to 1939 our follow up studies show the following: Twenty-one of our patients have been followed from 5 to 15 years. Fourteen patients have had no recurrence. During this period 3 have died of other proved causes. Three had recurrence, were reoperated upon, and are now well. Two

are living with recurrence. One patient has had repeated pathologic fractures of the right humerus and another has metastases in both lungs. One patient died of recurrent malignant disease of lateral aberrant thyroid origin. Of the other 9 patients, 6 had no recurrence after 4 years. One had a recurrence, was reoperated upon, and is now well. One patient is living with recurrence. The last patient died of metastases from carcinoma of the breast (2).

Our second group of 17 cases since 1939 encompasses a follow up period of only 6 years. In 14 of these patients recurrence was recorded, in 1 case after 4 years, followed by reappearance of lymph node metastases 1 year later. Reoperation on two different occasions revealed additional tumor. This patient is now well. Three cases are too recent to discuss.

The results of our follow up survey in the entire group confirm the pathologist's belief that tumors of lateral aberrant thyroid origin are of low malignancy. Adequate radical surgical treatment followed by radiation therapy offers a very favorable prognosis.

SUMMARY AND CONCLUSIONS

Tumors of lateral aberrant thyroid origin are discussed. These tumors arise from the ultimobranchial body as a result of departure from normal embryologic development.

Forty-seven instances of these tumors were encountered at the Labey Clinic up to July 1, 1945. During this same period 25,000 patients were treated for various types of goiter. Thus, one tumor of this type is seen in approximately every 500 goiter patients.

These tumors may occur in patients of any age but usually in those under 40 years. They are more frequent in women than in men.

Clinical diagnosis can usually be made. The lesion must be distinguished from the simple neck tumors: branchial cysts, carotid body tumors, and neurofibromas. In particular differentiation must be made from tuberculosis, lymphosarcoma, Hodgkin's disease, inflammatory glands, and metastatic carcinoma. Diagnosis is confirmed by biopsy.

The characteristic pathologic picture is a papillary cystadenomatous structure showing little if any differentiation into adult thyroid

structure. All these tumors must be considered as actually or potentially malignant.

Radical neck dissection followed by deep radiation therapy is the most satisfactory course of treatment. This lesion is of low malignancy and is radiosensitive.

The operative mortality in 47 cases was nil. Follow up studies of 30 patients prior to 1939 cover a period of 5 to 15 years. Twenty one of these patients showed no recurrence, 4 had recurrence, were reoperated upon and have remained well. Four died of other causes. One patient died of recurrent malignant disease of lateral aberrant thyroid origin.

Follow up study of our most recent 17 cases encompasses the past 6 years. One patient

had a recurrence, was reoperated upon twice and has remained well. Three cases are too recent to discuss.

In conclusion, whenever a biopsy specimen is taken of a tumor from the lateral region of the neck, and the report is papilliferous cyst adenoma or papillary adenocarcinoma, in all probability it is a lateral aberrant thyroid. Adequate surgical and radiation therapy will result in an ultimate favorable prognosis in the majority of cases.

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URINARY INCONTINENCE DUE TO BILATERAL ECTOPIC URETERS

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URINARY incontinence due to an ectopic ureteral orifice is not common. In 1938 Essendrach (1) reported a series of 355 cases of ureters with ectopic openings which he had collected from the literature. In most of the cases the condition was unilateral; bilateral ectopic ureters were infrequent.

The ectopic ureter is usually associated with complete duplication of the pelvis and ureter. In most instances the opening of the ureter which leads from the upper segment of the duplicated kidney is ectopic. Rarely the ureter from the lower segment is ectopic or an ectopic ureter may occur with a kidney which is not duplicated.

From the Section on Urology and the Division of Surgery, M. S. Clinic.



Fig. Excretory urogram. Duplication of the pelvis and calices of the left kidney is shown. II. Duplication of the right kidney is suggested by the small amount of medium visible in the upper pole.

In cases of bilateral ureteral ectopia the orifices of the ectopic ureters are most frequently situated in the urethra or the vestibule of the vagina. Less frequently one or both ureters enter the prostatic urethra, vas deferens, ejaculatory duct, uterus, or vagina.

The condition occurs with much greater frequency among women than among men and the outstanding symptom among women is urinary incontinence. In practically all cases the incontinence is congenital, diurnal and nocturnal and is associated with normal voidings. Among men incontinence is usually absent and the condition is discovered following investigation to determine the source of infection of the urinary tract.

The diagnosis of bilateral ectopic ureters may be exceedingly difficult and, at times, can be only inferred, as in Case 2. If the symptoms suggest ectopic ureter—the urethra, vestibule, and vagina must be carefully examined and a search made for the escape of urine from the ectopic orifice. The intravenous administration of indigocarmin is usually of little value because the function of the portion of kidney drained by the ectopic ureter is not sufficient to concentrate the dye in the urine. It may be possible to catheterize the ectopic ureters and to secure pyelograms, as in Case 1.

Excretory urography is valuable in the diagnosis of this condition. (a) In most instances bilateral complete duplication of the renal pelvis and ureters will be found. However, those segments of the kidney drained by the ectopic ureters (usually the upper) will be visualized faintly or not at all, because their function is insufficient to concentrate the contrast medium. In such instances the diagnosis of bilateral complete duplication must be inferred from the fact that the visualized pelvis (usually the lower) appear to drain only the lower portion of each kidney. Thus, if by excretory urography and retrograde pyelography a diagnosis of bilateral complete duplication of the pelvis and ureter is made and if but one ureteral orifice is situated at each extremity of the trigone, a diagnosis of bilateral ureteral ectopia can be made.

In instances in which the ectopic ureters empty into the urethra, the instillation of indigocarmin

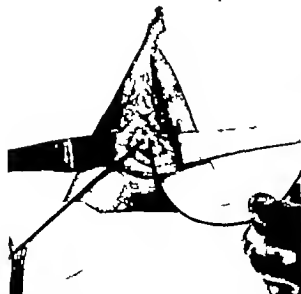


Fig. 1 The openings of the ectopic ureters into the vestibule of the vagina.

into the bladder is of diagnostic value as in Case 2. The escape of urine, uncolored with indigo-carmin, from the urethra after the dye has been instilled into the bladder is conclusive evidence of the presence of an ectopic ureteral orifice situated in the urethra.

Because of the infrequency of this condition the following 2 cases of bilateral ureteral ectopia are reported.

REPORT OF CASES

CASE 1: A single woman, 36 years of age, stated that she had had urinary incontinence since birth and that, as long as she could recall, her underclothes had been wet. At no time had there been any diurnal, seasonal or yearly variation; at all times her perineum was constantly and monotonously wet. As a child she had been examined and treated by several physicians but to no avail. Drastic limitation of fluids and voiding every hour by the clock, during the day and night produced no change. Her parents evolved a schedule whereby the child would receive as a reward a blue paper star for each day that she remained continent and a gold star for each week, strive as she might, the unfortunate child never earned a blue star.

During puberty and adolescence the patient reconciled herself to a wet perineum. As she matured, however, she found it necessary to change her residence to another state, chiefly because her friends complained of the urinous odor. Two years before coming to the clinic she again had sought medical aid. Cystoscopic examination had been performed and she had been informed that her right kidney was infected and that the cut-off muscle was weak. A plastic procedure whereby the muscles of the urethra were tightened had been carried out but without benefit.

She stated that she used three sanitary pads during the day and three during the night. She had no other urinary symptoms. She voided easily and painlessly three or four times daily and did not have nocturia.

The only pertinent finding in physical examination was inflammation and tenderness of the skin of the vulva and

thighs; the urinous odor of these parts was evident. Routine laboratory studies, including urinalysis, yielded normal or negative results. The concentration of urea was 22 milligrams per 100 cubic centimeters of blood.

An excretory urogram (Fig. 1) revealed complete duplication of the pelvis and calices of the left kidney; the visualization of the left ureter was not sufficient to determine whether this ureter also was duplicated. The pelvis and calices of the right kidney appeared to be normal; a small amount of medium appeared to be present in the upper pole of the right kidney above the visualized pelvis and suggested the presence of duplication. The right ureter was not visualized sufficiently for accurate diagnosis.

Cystoscopy revealed the bladder to be normal; one ureteral orifice was situated at either extremity of the trigone. Bilateral retrograde pyelograms outlined only the lower pelvis of both kidneys and these appeared normal. Specimens of urine which were collected from each kidney were negative microscopically and by means of Gram's stain.

Careful examination of the urethra failed to disclose an ectopic ureteral orifice. After the intravenous administration of indigo-carmin, diligent examination of the vestibule and considerable probing of various folds finally revealed two ectopic ureteral orifices (Fig. 2). The orifice of the ureter leading from the upper segment of the right kidney was situated directly below the urethral orifice and a ureteral catheter was passed with ease. The orifice of the ureter leading from the upper segment of the left kidney was situated below and lateral to the urethral orifice. A



Fig. 3 Retrograde ureterogram. The lower portion of the ureter from the upper segment of the left kidney is dilated and tortuous. The upper segment of the right kidney and its ureter are incompletely visualized.



Fig. 4. Bilateral retrograde pyelogram. Complete bilateral duplication with bilateral ectopic ureters is shown. Visualization of the upper segment of the left kidney and its ureter is poor because the catheter could be inserted up the ureter for only a short distance.

ureteral catheter could be passed up this ureter for only a short distance and retrograde pyelogram revealed marked dilatation and tortuosity of the lower third of the ectopic left ureter (Fig. 5). A retrograde pyelogram of the upper segment of the right kidney disclosed rudimentary pelvis and ureterectasis (Fig. 4). Examination of specimen of urine from this segment revealed pyuria and bacilluria.

A diagnosis was made of bilateral, complete duplication of the pelvis, calices and ureters, with the orifices of the ureters from both upper segments situated ectopically in the vestibule. Bilateral heminephrectomy was advised and carried out.

At the time of the first operation the right kidney was exposed and it was noted that the upper segment represented approximately one-third of the total renal mass. Two sets of aberrant vessels extended to the superior pole. The upper pelvis was situated posteriorly and its ureter passed through the structures of the renal pedicle (Fig. 5). The ureter as divided in its upper third and drawn through the renal pedicle. The aberrant vessels were separated and ligated separately and the upper segment of the kidney was excised.

Convalescence was uneventful but urinary incontinence persisted. In spite of our reassurance, the patient was perturbed because it was her impression that the urinary leakage had not been reduced by half.

Two weeks after the first operation surgical exploration of the left kidney was performed. The operative findings

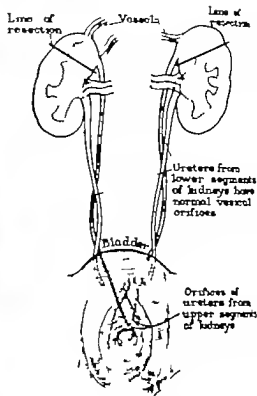


Fig. 5. Diagrammatic scheme illustrating the findings. Case 1.

and surgical procedures were essentially similar to those which have been described for the right kidney. Left heminephrectomy and partial ureterectomy were performed with ease.

After the second operation urinary incontinence ceased entirely. The patient was elated and stated, "It's like new life!" An excretory urogram made 3 weeks after the second operation revealed normal function in both remaining segments with no deformity of the pelvis or calices (Fig. 6). Urinalysis revealed normal findings and the concentration of urea was 30 milligrams per 100 cubic centimeters of blood.

CASE 2. A girl, 9 years of age, was brought to the clinic by her mother who stated that the child had been incontinent of urine since birth. More recently the patient had complained of burning in the region of the urethra. In all other respects the child appeared and behaved normally.

The pertinent finding on physical examination was the constant escape of small amount of urine from the external meatus. Urinalysis gave negative results. Routine studies of the blood and roentgenograms of the thorax were normal.

An excretory urogram suggested the possibility of complete duplication of the pelvis, calices and ureter of the left kidney. Although the upper segment could not be visualized, the position of the pelvis in relation to the soft tissue outline of the kidney suggested this possibility. The presence of a similar condition of the right kidney was also suggested, but details were obscured (Fig. 7).

Cystoscopic examination disclosed the bladder to be normal, with one urethral orifice situated at each extremity of the trigone. The internal vesical neck and urethral tube appeared normal. A small opening, as seen just inside the



Fig 6. Excretory urogram following bilateral heminephrectomy. Both lower segments are functioning normally. Visualization of the right kidney is incomplete.

external urethral meatus slightly to the left of the midline a catheter could be passed through this opening for only 1 centimeter. The remainder of the urethra appeared normal. Indigocarmine was instilled into the bladder and observation of the urethra did not disclose the escape of any blue-stained urine. However, an escape of clear urine from the urethra was noted at regular intervals. This finding was considered as evidence that the ureteral orifice corresponding to the upper segment of the left kidney entered the urethra. The possibility that an orifice from the upper segment of the right kidney was also situated in the urethra was considered. A recommendation of exploration of the left kidney was made. In the event that incontinence persisted after this procedure, a similar procedure on the right kidney was advised.

Exploration of the left kidney was carried out and complete duplication of the pelvis and ureter was noted. The upper half of the kidney was found to consist of a hydronephrotic sac with little parenchyma remaining. The ureter leading from the upper segment was tortuous and approximately 1 centimeter in diameter. The remainder of the kidney and the ureter from the lower segment appeared normal. Heminephrectomy, removing the upper segment, was carried out. The pathologist reported hydronephrosis, chronic pyelonephritis and hydroureter: 90 per cent of the renal substance had been destroyed.

The patient without the procedure well and convalescence was uneventful. Urinary incontinence, however, persisted. Excretory urography was repeated and the pelvis of the right kidney appeared normal but was seen to



Fig 7. Excretory urogram. The size, position, and configuration of the pelvises suggest duplication of the pelvis and calices.

occupy the lower half of the soft tissue outline of the right kidney. Considerable renal parenchyma appeared to exist above the visualized pelvis and this finding strongly suggested the possibility of duplication of the pelvis, calices and ureter of the right kidney. The remaining lower segment of the left kidney was not visualized satisfactorily but it appeared to be functioning normally.

Cystoscopy was repeated and the urethra was carefully examined, but a second ectopic ureteral orifice could not be found. Indigocarmine was again instilled into the bladder and again an escape of clear urine from the external urethral meatus was noted. This finding was considered as conclusive evidence of complete duplication of the right kidney with the ectopic opening of the ureter from the upper segment situated in the urethra.

Exploration of the right kidney was advised and carried out and complete duplication of the pelvis and ureter was found. The upper segment of the kidney was hydronephrotic and the corresponding ureter was extremely dilated. The lower segment of the kidney and its ureter appeared normal. Heminephrectomy, removing the upper segment, was carried out. The pathologist reported hydronephrosis, chronic pyelonephritis, and hydroureter: 10 per cent of the renal parenchyma was destroyed.

After the second operation the patient had perfect urinary continence. Convalescence was uneventful. An excretory urogram revealed normal configuration of the lower segments of both kidneys and both appeared to be func-

tioning normally. Ten years after the last operation the patient informed us that she had no urinary symptoms.

COMMENT

A correct diagnosis of ectopic ureter will enable the physician to achieve a brilliant cure by the proper surgical procedure—usually heminephrectomy. Female patients, miserable as a result of urinary incontinence, can be restored to perfect continence and male patients can be relieved of

intractable urinary infection by proper diagnosis and surgical treatment. If incontinence persists among female patients after unilateral heminephrectomy, bilateral ureteral ectopia is suggested and further urologic investigation of the opposite kidney, including exploration if necessary, is indicated.

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STUDIES ON EXOPHTHALMOS PRODUCED BY THYROTROPIC HORMONE

III Further Study of Changes Induced in Fat by Thyrotropic Hormone (Tissue Reactions Associated With Exophthalmos)

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IN a preceding publication (11) the reports of Paulson Aldred Brock and Smelser which described the presence of round cells in the tissues of animals given thyrotropic hormone were confirmed. Paulson (17-18) concluded that the reaction he described as Zenker's degeneration in muscle was most marked in the first few days of the administration of the hormone. I recently reported (11) that these new cellular components which appeared in tissue contained tiny droplets of fat and that the general reaction in fat depots was comparable to the reparative processes which occur in traumatized fat with fat necrosis. Fat was demonstrated by histologic techniques, in abnormal quantities not only in macrophages of connective tissue but in cardiac and skeletal muscle fibers, in liver and kidney epithelium in epithelium of the ileum and in reticuloendothelial cells throughout the body.

The nature of the reaction and the presence of fat droplets in macrophages and polymorphonuclear leucocytes of connective tissue led to the assumption that this was phagocytosis of fat and probably a form of rapid mobilization of fat. Because fat seemed to be removed from depots and appeared elsewhere in seemingly abnormal quantities, the supposition was that fat was being rapidly transported, perhaps via the blood stream. Preliminary investigation on centrifuged blood revealed lipemic plasma and a marked increase of the thickness of the buffy coat suggesting leucocytosis. In previous studies with antuitrin T the fat depots did not readily recover their depleted fat and the fat that appeared elsewhere disappeared rapidly. This prompted the question whether fat was being metabolized more rapidly than usual. Accordingly experiments were devised for the consideration of the following topics: (1) the sequence of events in the histologic changes induced in connective tissue and liver of guinea pigs

(2) a study of blood fats in such animals (3) a study of blood acetones in such animals and (4) changes that may take place in leucocytes in the circulating blood

METHODS

Inasmuch as the changes in the connective tissue of normal animals are as great as in thyroidectomized animals when thyrotropic hormone is administered normal intact animals have been used. The study was based on 14 animals receiving antuitrin T² 2 receiving purified thyrotropic factor⁴ 4 receiving specific metabolic principle and 8 normal control animals. Most interest centered about the animals receiving antuitrin T for it was this product which induced the most striking reaction in tissues (11). Twelve of the animals which received 1 cubic centimeter of antuitrin T³ were killed in 3 1/2 to 24 hours after the single administration. The remaining 2 received daily administration of antuitrin T for 2 and 3 days respectively before being killed. All animals were killed by exsanguination by means of an 18 gauge needle inserted through the thoracic wall into the heart.

Coagulation of the blood so obtained was inhibited with sodium oxalate crystals. The blood was centrifuged slowly and only sufficiently to separate the cells from the lipemic plasma. The plasma was dried, ground finely with sand and extracted three times (1 hour each) with a solvent composed of 50 per cent methyl alcohol and 50 per cent chloroform. After evaporation of the solvent, the residue was dissolved in chloroform, filtered dried and weighed.

The determination of blood acetone⁵ was done by the method of Crandall on whole blood.

One cubic centimeter of antuitrin T was reported by the manufacturer to contain 5 Junkman-Schoedler units. This unit is defined as that amount of extract which when injected daily for 3 days into guinea pigs weighing 100 and 50 grams causes recognizable hypertrophy of the epithelium and disappearance of colloid in the thyroid of out of 4 animals (3, 4).

I am indebted to Dr. Eunice Brock, of the Division of Experimental Medicine, Mayo Foundation, for her assistance in the determination of blood acetone in this experiment.

Abridgment of thesis submitted by D. Dobys to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Ph.D. in Surgery. Dr. Dobys, Fellow in Surgery, Mayo Foundation.



Fig. Phagocytosis of fat droplets by tissue macrophages and polymorphonuclear leukocytes in penturetic depot of an intact animal that had been given 5 cubic centimeters of antuitrin T daily for two days. This is the picture seen early after the beginning of the administration of antuitrin T. Some of the large macrophages suggest transformation into fibroblasts (scarlet red and hematoxylin, X750).

Determinations of fat in the plasma were made on 12 animals that received antuitrin T. Eight of these animals were also studied for blood acetone. Eight of the normal animals were studied for plasma fat and 5 of that number for blood acetone.

Attention should be drawn to the fact that some of the antuitrin T that was used had been heated at a temperature of between 95 and 99 degrees C. and pH 7 for 1 hour. This heated product caused the usual changes in fat, in connective tissue, and in organs just as the unheated product did (11).

The leucocytes from the circulating blood of these animals were studied. The cells were drawn up in a pipet from the buffy coat of the centrifuged blood. The cells were smeared on a clean slide, fixed in formalin and stained with scarlet red and hematoxylin. Such preparations were made in duplicate and triplicate to avoid misinterpretation of artifacts. This procedure served as a means of judging the presence of fat droplets in the leucocytes of the blood stream.

The liver, spleen, temporal muscle, cardiac muscle, lung, thyroid, orbital contents and fat from several depots, including periretens, axillary, cervical and testicular fat were all studied microscopically. These were fixed in 10 per cent formalin, sectioned on a freezing microtome and stained with scarlet red and hematoxylin. The pathologic changes were graded on a basis of 1 to 4 (1 being the slightest discernible change and 4 being the most striking).

RESULTS

As described previously (10) antuitrin T caused the animals to become inactive, muscularly weak and rough-coated within a few hours. The same animals which were most profoundly affected had grossly cloudy blood plasma.

The development of histologic changes. The abnormal appearance of fat in many different tissues was very evident in animals which had received a single administration only a few hours before. The liver, muscle, kidney, epithelial cells from several locations, the reticulo-endothelial cells of the lung and spleen and the polymorphonuclear leucocytes, tissue macrophages and fibroblasts of connective tissue throughout the body were sites of abnormal quantities of fat. The degree of change with regard both to the deposition of fat in abnormal quantities in various locations and to the development of the cellular reaction (with phagocytosis) in the connective tissue, became more evident as time elapsed following the injection of antuitrin T. Two animals which received antuitrin T for only 3½ hours before they were killed showed changes which could be graded only 1 to 2. Two other animals killed in 5 hours showed changes which were graded 2 to 3. By 21 and 24 hours these changes were striking, being graded 3 to 4. The tissue changes in these animals after a single injection were compared with those that were found after numerous daily administrations of antuitrin T (11). In animals treated for longer periods there were a decreasing amount of phagocytosis of fat and less fat in the liver, kidneys, muscle fibers and so forth. The new cellular elements appearing in the connective tissue remained striking but the fat droplets in such cells progressively diminished as longer periods of administration of antuitrin T were observed.

During the first few hours after the administration of antuitrin T the cellular reaction in connective tissues consisted of relatively more polymorphonuclear leucocytes and large tissue macrophages. After longer periods the polymorphonuclear leucocytes had become relatively infrequent and fibroblasts and lymphocytes had increased.



Fig. 2a.

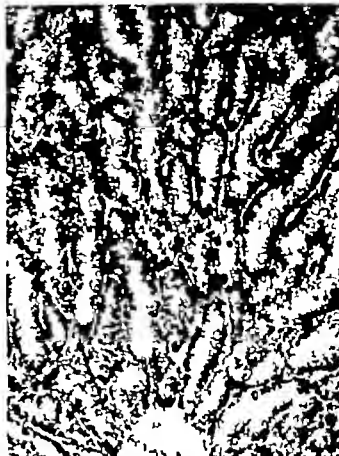


Fig. 2b.

Fig. 2. Microscopic deposition of fat in the liver of animals receiving antuitrin T ($\times 285$). a, Three and a half hours after administration of antuitrin T. b, Five hours after. c, Twenty-four hours after.

The lymphocytes did not contain demonstrable fat droplets. Several things suggested a transformation from large mononuclear macrophages into fibroblasts. The incidence of fibroblasts seemed less very early but more common later. Cells could be found in all stages of transformation. Fibroblasts contained fat droplets just as were found in the macrophages but the quantity of fat contained had become less prominent (Fig. 1). These cellular changes were thus found to be a forerunner to the increase of connective tissue throughout the body seen particularly well in fat depots and described elsewhere (11). After 15 or more days of daily administration of antuitrin T the acute phase of the reaction had seemingly passed and in its place an increase of connective tissue was found.

The sequence of changes induced in the liver. Special attention was directed toward a sequence of changes in the liver. It was known from former experiments (11) that antuitrin T caused the appearance of fat in the liver. In 3½ hours very minute droplets of fat could be seen in the margin

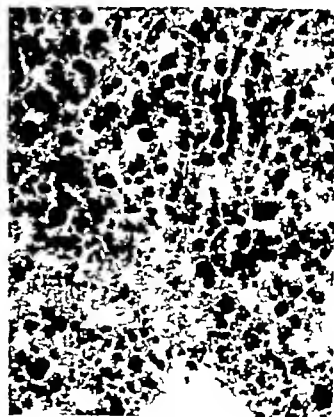


Fig. 2c.

of the hepatic cells bordering the blood sinusoids. In 5 hours the fat droplets were larger and more numerous but still occupied that portion of the hepatic cells bordering the blood sinusoids. The fat was somewhat more abundant in the periportal region of each liver lobule than in other regions. Finally in 24 hours the hepatic cells were almost completely filled with fat droplets (Fig. 3). These changes were all induced by a single injection of antultrin T. This progressive accumulation of fat entering hepatic cells next to the blood sinusoids, adequately supports the hypothesis that fat is transported to the liver via the blood stream. An increased presence of fat in the periportal region of the lobule contributes additional support.

Changes induced in the thyroid epithelium. The epithelium of the thyroid gland contained many tiny fat droplets in the cytoplasm of the cell 24 hours after administration of a single large dose of antultrin T. The fat droplets were most numerous toward the base of the cell. Such droplets were not demonstrable in the thyroid cells of normal animals. Although this observation was made rather consistently the relationship of these fat droplets to the developing hyperplastic state in the cells is not understood (Fig. 3).

Changes induced in the hardenian gland. The hardenian gland, which lies within the orbit inside the periorbital, is a ceruminous gland. Its waxlike contents stain deeply with scarlet red. After the administration of antultrin T the normal waxlike contents of the cells of this gland were reduced in some animals in which considerable alteration of fat was observed elsewhere in the body. However the fact that the fat changes in this gland in some animals were not consistent with other fat changes casts some doubt on this relationship.

Results of plasma fat determinations. The presence of lipemic plasma in many of these animals which were treated with antultrin T has been mentioned. Quantitative determinations of plasma lipids after administration of antultrin T. The plasma lipids ranged from 140 milligrams to 400 milligrams per 100 cubic centimeters of plasma in the 8 normal animals. Animals killed 3½ to 5 hours after administration of a single dose of antultrin T showed no appreciable rise of plasma lipids when compared with normal animals. On the other hand after 21 to 24 hours plasma lipids were found to be as high as 1,050 milligrams per 100 cubic centimeters of plasma. Only 2 of 8 such animals were found to have plasma lipid levels which were within the range of the normal animals.

Results of blood acetone determinations. Blood acetone was calculated in terms of beta-oxybu-

tyric acid. Blood acetone of 5 of the 8 normal animals was determined. The range in these animals was 1.9 milligram to 3.3 milligrams per 100 cubic centimeters of whole blood. Seven of the eight animals which were killed in 21 to 24 hours after a single injection of antultrin T were studied for blood acetone. In this group of animals the range was 7.4 milligrams to 12.9 milligrams per 100 cubic centimeters of whole blood. Although the method of determining blood acetone may be open to some criticism, the results suggest a change in these animals that have received antultrin T.

Results in animals treated with so called purified thyrotropic factor. Two animals received 1 cubic centimeter of so called purified thyrotropic factor containing 5 Rowlands-Parkes units and were killed in twenty hours. The plasma fat was not elevated in one (380 mgm per 100 c.c. of plasma) and only very slightly elevated in another (47 mgm per 100 c.c.). Blood acetone in these animals was 0.4 milligrams and 8.3 milligrams per 100 c.c. of blood respectively. Animals receiving the specific metabolic principle showed no appreciable change in plasma fats in tissue.

Cellular changes induced in blood by thyrotropic hormone. This report is based on the following animals: 5 received antultrin T, 3 received a crude thyrotropic preparation, 3 received specific metabolic principle and 4 were normal animals. Most interest centers about the animals which received antultrin T. Not only was there an increase in the thickness of the buffy coat of the blood of animals treated with antultrin T but the polymorphonuclear cells were in great excess. A differential leucocyte count on the animals given antultrin T revealed that 82 to 94 per cent of the cells were polymorphonuclear leucocytes in 4 of the 5 animals. This is in marked contrast to the normal animals, which had 5 to 14 per cent of polymorphonuclear leucocytes in 3 of 4 animals. In the fourth animal the proportion was 50 per cent. Because of the striking increase of the thickness of the buffy coat in the blood of animals treated with antultrin T it may be assumed that the reversal of the ratio represented a polymorphonuclear leucocytosis.

A crude thyrotropic preparation caused a polymorphonuclear leucocyte response in the circulating blood similar to that produced by antultrin T. The specific metabolic principle caused a similar response in 2 of the 3 animals.

¹One Rowlands-Parkes unit is the amount which has been found to double the weight of tissue weight of the milligram (20 for 8 day rats, 200 gram female rats, 200 g will cause the thyroid double its weight of tissue weight of the milligram (20).

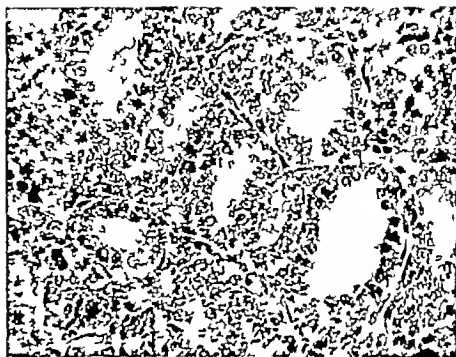


Fig. 3 Fat droplets in the thyroid epithelium 24 hours after administration of a single large dose of antitritin T (scarlet red and hematoxylin. $\times 300$)

Studies on Exophthalmos Produced by Thyrotropic Hormone III Further Study of Changes Induced in Fat Thyrotropic Hormone (Tissue Reactions Associated with Exophthalmos) —Brown M. Dobyns

The fat stained smear of the cells comprising the huffy coat showed fine droplets of fat in the polymorphonuclear cells. These fat droplets were very abundant and large in animals treated with antuitrin T but they were relatively small and much less frequent in the cells of the blood of normal animals or animals that had been treated with specific metabolic principle. Animals that had been treated with the crude thyrotropic preparation showed some increase of fat in polymorphonuclear leucocytes but less than the increase in animals treated with antuitrin T. A rather definite correlation was found between the presence of fat droplets in the cellular elements appearing in connective tissue and the presence of fat in the polymorphonuclear leucocytes of the circulating blood.

COMMENT AND CONCLUSIONS

In a former publication (11) there was described phagocytosis of fat in the cells which were taking part in the connective tissue reaction in animals which received pituitary thyrotropic preparations. Associated with this change were the rapid replacement of fat in fat depots by a clear gelatinous substance and the appearance of fat in many locations including the liver muscle and various epithelial and reticuloendothelial cells. In this study it has been found that after a single administration of thyrotropic hormone (antuitrin T especially) there is a rise of the plasma lipoids and of the blood acetone simultaneously associated with changes of the lipoids in many organs. These data further contribute to the belief that fat is being rapidly mobilized.

Studies of the liver reveal a progressive deposition of fat in the hepatic cells first appearing within a few hours in the edge of the hepatic cell bordering the blood sinusoids and progressively occupying more and more of the cytoplasm of the hepatic cells. Best and Campbell have shown that whole anterior pituitary extract caused fine droplets of fat to appear in the hepatic cells. This was most striking in 3 days but considerably less after 9 days. This has been confirmed with the thyrotropic preparations used in these experiments.

Anselmino and Hoffman recognized a ketogenic property in thyrotropic hormone but reported that the ketogenic action took place only if the thyroid was present. In contrast Houssay and Rietti reported such a ketogenic substance which acted in the absence of the thyroid. In the investigation described here only intact animals were used to illustrate the elevation of plasma fat and blood acetone. However all of the other tissue

reactions which were associated with the changes of plasma fat and blood acetone have been found in thyroidectomized animals just as they were found in intact animals (11).

It has been the belief of Boyd and Wilson that the polymorphonuclear leucocytes did not participate in the transportation of fat. In these experiments on the influence of thyrotropic hormone in which there was evidence of rapid transfer of fat there was also evidence that polymorphonuclear leucocytes of the blood stream contained more fat than normally. Presumably they participated in the transfer of fat. Furthermore polymorphonuclear leucocytes are found in great abundance in fat depots and they also are heavily laden with fat here as well as in the blood stream.

By chemical analysis but not by histologic technique Dible and Libman have demonstrated an increase of muscle fat of the fasting animal. I have illustrated elsewhere (11) an increase of muscle fat by histologic technique however the amount of muscle fat found in these fasting animals is very slight compared with the extreme amounts seen soon after the administration of thyrotropic hormone.

Paulson (16) has described changes in hematoxylin and eosin preparations of the hardenian glands, which he interpreted as degenerative. In the studies described here using fat staining technique it seems that the changes in the vacuolation of the cells in some animals receiving antuitrin T represent changes in the amount of lipid content. The connective tissue reaction found there is probably a part of the generalized connective tissue reaction found throughout the body.

There is a very interesting correlation between the elevation of the plasma lipoids and the appearance of lipid in the liver. In 3½ to 5 hours the appearance of lipid in the liver was comparatively slight. It was in these animals that normal plasma lipid levels were found however after 21 to 24 hours the livers were loaded with fat and in the same animals most of the plasma lipoids were found to be elevated.

In a previous publication (11) I pointed out the correlation between exophthalmos and the changes in fat with associated connective tissue reaction when thyrotropic hormone was given. MacKay and Sherrill have shown a diminution of the lipid content of the bodies of thyroidectomized rats while the body weight remains the same. Whether the fat is catabolized is uncertain. I have shown that thyroidectomy in guinea pigs and man results in an increase of the prominence of the eyes. This fact also suggests a relationship between fat metabolism and exophthalmos.

It is a well known fact that in clinical subjects following thyroidectomy the blood lipoids tend to rise and the basal metabolic rate falls. Solev (23, 24) and I (9) have both shown that with such a fall of the basal metabolic rate there is an associated increase of the prominence of the eyes in clinical subjects. That there may be similarity in these two groups of circumstances seems possible.

SUMMARY

The edema and cellular reaction in connective tissue of animals made exophthalmic with thyrotropic hormone have been studied more extensively than in former investigations.

Following the administration of thyrotropic hormone the appearance of fat in the liver skeletal and cardiac muscle epithelial cells of several locations, phagocytic cells in the lungs, spleen and lymph nodes and in polymorphonuclear leucocytes and tissue macrophages has been further studied with respect to the sequence of events taking place. The earliest cellular reaction was composed principally of polymorphonuclear leucocytes and macrophages but later lymphocytes and fibroblasts which had transformed from macrophages were most numerous. These features have developed simultaneously with the exophthalmos.

The sequence of appearance of fat in liver cells was demonstrated first as tiny fat droplets adjacent to blood sinusoids and later occupying the entire cell.

The demonstration of the appearance of tiny fat droplets in the cytoplasm of the thyroid epithelium at a time when the gland was becoming rapidly hyperplastic from the administration of thyrotropic hormone was an observation which was presumed to be related to the other phenomena observed.

The plasma fat and blood acetones became elevated simultaneously with the changes in the lipid content of many organs.

Associated with these changes was a polymorphonuclear leucocytosis. These cells were found to contain an excessive number of fat droplets in contrast to cells in the blood stream of normal animals. It is presumed that these fat laden poly-

morphonuclear leucocytes in excessive numbers in the blood stream have some relation to the similar cells which contain fat and are so abundant in fat depots and connective tissue.

These studies shed additional light on the round cell infiltration described by others in exophthalmic animals and perhaps in man. Clinical observations are briefly discussed in the light of these findings.

NOTE: Since the completion of this investigation there has appeared in the literature a study by Rundle and Peck which indicates an increase in the fat content of eye muscles in cases of exophthalmic goiter. Clin. Sci., 1944, 5: 74.

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SPONTANEOUS GASTROINTESTINAL BILIARY FISTULAS

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CONTRARY to accepted opinions spontaneous gastrointestinal biliary fistulas are not medical curiosities. Kehr (11) encountered 100 such fistulas during the routine performance of 2 000 cholecystectomies. Puestow found that 3.5 per cent of all patients having operation on the biliary tract had these troublesome complications. The 15 cases forming the basis of this report represents an incidence of 4.2 per cent. Therefore one of every 25 patients requiring surgical therapy for disorders of the biliary tract will possess some variety of internal biliary fistulas

PATHOLOGY

Gastrointestinal biliary fistulas are always secondary to other pathological processes. It is interesting to note that gall stones proved to be the provocative agent in 90 per cent of reported cases. The close proximity of the gall bladder and choledochus to the duodenum invites the eroding calculi to escape into this portion of the alimentary tract. Six per cent of these spontaneous fistulas are produced by perforating peptic ulcers. If the ulcer is situated on the posterior surface of the duodenum they usually perforate into the choledochus, while those located on the lateral duodenal wall ulcerate through into the gall bladder. Gastric ulcers, on the other hand invariably involve the gall bladder. Cancer of the stomach, pancreas, gall bladder and common bile duct produces a degenerative necrosis of contiguous viscera so that a variety of internal biliary fistulas result. We have seen one cholecystogastric and one choledochopancreaticoduodenal fistula associated with invasive neoplasms.

An anatomic study of 272 gastrointestinal biliary fistulas reveals the incidence with which the various organs are involved. The gall bladder was involved in 88 per cent, and the common bile duct in 11 per cent. The gastrointestinal component consisted of the duodenum in 69 per cent, colon in 26 per cent and stomach in 4.4 per cent. Other fistulas were so rare as not to require notation.

The biliary dysfunctions following the formation of the gastrointestinal fistula depends largely on the nature of the causative lesion (9). Two courses are open either the fistula closes sponta-

neously or serious disturbances of the hepatobiliary system result. There is abundant evidence indicating that these fistula can and do heal voluntarily. Numerous cases have been reported wherein all biliary symptoms subsided after the gall stones had eroded into the duodenum and escaped with the feces. Two of our patients passed very large gall stones per rectum and yet subsequent operations failed to reveal any communication with the intestinal tract. In each instance the gall bladders and duodenum were so adherent to each other that they formed a homogeneous mass of scar tissue. Apparently the gall stones, by a process of ulcerative necrosis had escaped into the duodenum and the fistulous tract had been obliterated by fibrosis. We have seen cholecystoduodenal fistulas close spontaneously as soon as the provocative duodenal ulcer had become quiescent under strict management.

As a rule however the formation of these internal biliary fistulas intensifies the existing hepatic dysfunctions by producing a suppurative cholangitis, hepatitis and obstructive jaundice (3). Why do spontaneous biliary intestinal fistulas invariably produce a suppurative cholangitis while this complication seldom accompanies similar operative fistulas? In both instances regurgitated intestinal contents can be found in the biliary radicals. The explanation lies in the fact that pathological fistulas have a concomitant choledochal obstruction with the resulting stasis of bile. For example, before a migrating gall stone a perforating ulcer or a necrotizing malignant growth can produce an internal biliary fistula they provoke such an intense inflammatory swelling of contiguous tissues that a compressive occlusion of the common bile duct occurs. When the static bile becomes infected, the ensuing pancreatitis and cholangitis intensifies the choledochal obstruction.

Cholangiographic studies performed on the operating table indisputably confirm the presence of choledochal obstructions. In all of our operative cases the terminal choledochus was so completely occluded that injected diodrast could not be forced through the ampullary opening into the duodenum. Figures 2, 3 and 5 reveal that ingested barium is still incarcerated in the common bile duct 6 hours after the main body of the barium meal has passed from the duodenum into the lower ileum and colon. Tracey and McKell

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Fig. 1. a. The prepyloric area of the stomach is occluded by an infiltrating, proliferative tumor. The barium was seen to pass from the stomach through fistula into the gall bladder but none of the barium traversed the cystic duct. Note the presence of gall stones. b. A progress film taken 6 hours later shows some of the barium in the intra-



hepatic bile ducts indicating patent cystic duct. The gall bladder still retains some barium even if the main biliary canal has progressed to the colon. Cholecystectomy thus is patent but provides inadequate drainage.

believe that the obstruction of the common bile duct with the ensuing biliary stasis constitutes the most important pathological condition encountered in these cases and it must receive primary consideration.



Fig. 2. a. Under fluoroscopic vision the barium was seen to enter the gall bladder through duodenal fistula and then flow through the cystic duct into the choledochus. Observe the pronounced dilatation of the bile ducts indicating an ampullary obstruction. The gall bladder contains gall stones. b. Same patient 6 hours later demonstrating

complete retention of the choledochal barium because of an ampullary obstruction. Note that the barium has escaped from the stomach and duodenum yet the common bile duct cannot evacuate its content through the ampulla of Vater. The dilatation of the extrahepatic and intrahepatic bile ducts signifies chronic obstructive process.



Fig. 3. a, The barium meal was seen to pass from the duodenum into the upper segment of the common bile duct by means of a choledochoduodenal fistula. No barium escaped into the gall bladder until the entire common duct was filled, and then the barium seeped along the patent cystic duct. The dilatation of the bile ducts indicates the

presence of a chronic ampullary obstruction. b, A film taken 6 hours later clearly outlines the dilated choledochus and reveals barium in the intrahepatic radicals. Note the complete ampullary obstruction which is present. This finding has been constant in all cases of biliary intestinal fistula.

SYMPTOMS

Gastrointestinal biliary fistulas produce no identifying group of symptoms but rather mimic the characterizing syndromes of the parent pathologic conditions from which they arise. For example, there are no special signs to tell whether a peptic ulcer has merely perforated into the periduodenal tissues or actually eroded into the common bile duct. Likewise an obstructive carcinoma of the stomach seldom announces that it has ulcerated into the gall bladder thereby producing a cholecystogastric fistula. The jaundice, colic, and septic reactions accompanying a choledochal stone cannot be differentiated from those arising with a choledochoduodenal fistula. So confusing is the clinical picture that the physician seldom makes a preoperative diagnosis unless the fistulas have been inadvertently discovered by the radiologist (2).

It has been pointed out that the formation of the internal biliary fistula might result in a sudden cessation of all pre-existing complaints (11). This is particularly true if the newly formed fistula effectively drains the static bile. While such fortuitous circumstances are not usual they do occur. We agree with Puestow however that the formation of the fistula usually intensifies the patient's discomfort. Nausea, vomiting, chills, fever, jaundice and colic usually compel them to seek relief.

DIAGNOSIS

The preoperative recognition of gastrointestinal biliary fistulas depends entirely on the radiologist. In reviewing the literature Borman and Rigler found that of 267 fistulas only 86 were recognized preoperatively and in each instance the diagnosis was made by the roentgenologist.



Fig. 4. This represents a reflux filling of the common bile duct associated with a duodenal ulcer. Note the irregular appearance of the duodenal cap. The biliary radicals were not dilated. A film taken one hour later failed to outline the choledochus for the barium has escaped back into the duodenum and passed into the lower intestinal tract.

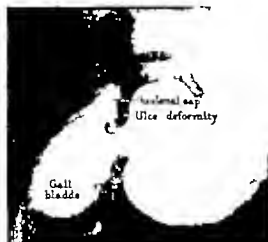


Fig. 5. a, The ingested barium outlines normal stomach—a spastic pyloric ring and an irregular duodenal cap. The barium passed from the duodenum into the gall bladder thus making the diagnosis of cholecystoduodenal fistula secondary to peptic ulcer. b, After the abdomen is opened the distended gall bladder, as injected with 75 per cent diodrast. Observe the distended gall bladder and the escape of the diodrast through the fistula into the duodenum. The common bile duct is well visualized and no stones were detected. c, The cholecystoduodenal fistula was occluded by means of a rubber shoe clamp. The cholangiogram taken 30 minutes later demonstrates stasis of contrast media, for practically none of the diodrast escaped through the ampulla of Vater into the duodenum. This film confirms our contention that most internal biliary fistulae have concomitant pancreatitis which produces partial or complete obstruction of the choledochus.

In their personal series of 24 cases they made a correct radiological diagnosis in but 37 per cent. Garland and Brown were able to make a diagnosis of gastrointestinal biliary fistula in 5 cases which they studied and they assert it is the only method of making an accurate diagnosis.

The roentgenographic demonstration of ingested barium, or gas, or both in any segment of the biliary tract is presumptive evidence of a fistulous communication with the gastrointestinal tract (12). The most important single finding is the presence of barium in the biliary radicals. In only 3 other conditions does barium have access to the bile ducts. One of these is in the presence of operative internal biliary fistula and the other is where the barium regurgitates along a gaping common duct when the sphincter of Oddi is relaxed. Fluoroscopic studies usually afford an effective means of differentiation.

Cholecystogastric fistulas are recognized by the passing of the barium from the stomach

through the pathologic stoma into the gall bladder (Fig. 1a). After filling this viscus the contrast medium flows through the patent cystic duct into the common bile duct (13). Usually the sphincter of Oddi is so spastic and the pancreas so swollen that they effectively obstruct the ampulla of Vater thus preventing the barium from escaping into the duodenum. This observation is very important (Fig. 3).

Cholecystoduodenal fistulas present a different picture. The barium first fills the stomach and then passes through the pylorus into the duodenum whence it gains entrance to the gall bladder through the fistulous tract (Fig. 5). The common bile duct is not visualized unless the cystic duct is patent.

In choledochoduodenal fistulas the barium will be seen to enter the duodenum in a normal manner and then flow through the fistula into the common bile duct (Fig. 3 a). It is important to note that the barium always fills the lower

end of the choledochus first and after it becomes filled the barium ascends along the common bile duct flows through the patent cystic duct, and fills the gall bladder. Progress films invariably reveal the barium to be incarcerated in the common bile duct 6 to 12 hours after the ingested barium has passed from the duodenum into the lower intestinal tract (Fig 3 b).

Fortunately the reflux regurgitation of the barium meal along the atonic common bile duct occurs very infrequently and presents certain identifying signs (13). Fluoroscopically the barium can be seen to pass from the stomach into the duodenum, and as the duodenum becomes distended the barium slowly ascends the ampulla of Vater and completely fills the dilated common duct in a progressive manner (Fig 4). The barium however does not remain in the common duct but readily escapes through the gaping sphincter of Oddi and goes along with the main barium meal into the lower segment of the bowels. This passage of bile is in striking contrast to the choledochal retention seen in all cases of gastrointestinal biliary fistulas.

The presence of gas within the lumen of the gall bladder or the regional bile ducts furnishes indisputable x-ray evidence of a spontaneous gastrointestinal biliary fistula provided one eliminates similar gaseous shadows associated with an emphysematous cholecystitis (16) regurgitation of gas along an atonic choledochus or through an operative fistula. Rees (13) asserts that the reflux regurgitation of intestinal gases through an atonic sphincter of Oddi is so infrequent that it need not be considered. The utilization of barium meal usually provides accurate differentiation. McCorkle and Fang (10) emphasize the fact that in an emphysematous cholecystitis the gas, derived from bacterial action is usually confined within the gall bladder. In rare instances they were able to demonstrate bubbles of gas loculated within the walls of the gall bladder or confined to the percholecystic structures. This finding indicates an extension of the phlegmonous process. If the films are taken with patient in an upright position one can occasionally detect the fluids in the lower portion of the gall bladder supporting an upper stratum of gas. Duodenal intubation may permit the recovery of *Bacillus welchii* organisms.

Borman and Rigler maintain that the radiologist is so accustomed to seeing gas in the duodenum and colon that he frequently fails to consider the possibility that isolated bubbles of gas may be incarcerated in the biliary system. If the gas is confined within the common bile duct it

assumes a tubular shape which corresponds to the anatomic position of the choledochus. This gas bubble maintains a constant position which is not the case with collection of intestinal gases. Confirmatory evidence can be obtained by the administration of a barium meal.

When the diagnosis of internal biliary fistulas has been established the radiologist should make an attempt to determine the patency of the intestinal tract (2). If the migrating stones are large enough they frequently produce an acute intestinal obstruction. Scout films may furnish indirect evidence by revealing the presence of gaseous distention loculated pockets of intestinal fluids, or by localizing the offending stones. If the clinical picture is not that of complete obstruction the ingestion of a thin mixture of barium is most helpful. Such information is invaluable for the surgeon cannot hope to correct the biliary fistula while the intestinal tract is obstructed. The obstructive complication requires primary consideration.

Cholecystocolic fistulas are usually identified by a barium enema. If such enema does not outline the fistulous tract Faust and Mudgett found that the use of double contrast enema causes the insufflated air to pass through the patulous fistula so that the gas filled biliary system becomes visible.

SURGICAL MANAGEMENT

Patients having internal biliary fistulas are not good surgical risks. Dehydration, acidosis, toxemia, hypoproteinemias, all combine with the coexisting cholangitis, pancreatitis, and biliary obstructions further to depress essential functions of the liver. It requires several days of a carefully planned preoperative regimen before these patients can safely assume the added burdens of an operation. To ignore this essential preparation is to invite a high morbidity and mortality rate as indicated by reported cases.

There is no single operation which can be employed to correct all of these abnormal biliary fistulas. The remedial procedures depend on the viscera involved, the size and location of the fistulous orifices, the presence of obstructive pancreatitis, cholangitis, subhepatic abscesses and choledochal stones. Each case must be individualized.

Fistulas between the gall bladder and the gastrointestinal tract. Our plan has been to open the abdomen and make thorough palpatory examination to determine the location and extent of the provocative lesions i.e. gall stones, peptic ulcers or new growths. The gall bladder and its

fistulous tract are not molested until complete cholangiographic visualizations of the entire biliary system have been made (Fig 5 b). Visualization is quickly accomplished by inserting a No. 30 gauge needle into the fundus of the exposed gall bladder and evacuating its fluid content; then about 30 cubic centimeters of 70 per cent diodrast is introduced into the gall bladder and an x ray film is made. If the diodrast has escaped into the alimentary tract it clearly outlines the size and position of the fistula. A soft rubber-snob clamp is applied to the sinus tract and an additional 30 cubic centimeters of diodrast is introduced into the gall bladder. As the contrast medium cannot escape from the gall bladder through the fistula it will be compelled to flow along the cystic duct and fill all the biliary radicals (Fig 5 c). This affords an excellent roentgenographic pattern of the bile ducts, noting stones, strictures, and choledochal obstructions. With such information the surgeon can intelligently plan the necessary corrective operations.

When dealing with gastric malignant new growths which have extended into the gall bladder the invasive process is so extensive that resection is out of the question. The neoplastic process has usually compressed the common bile duct and the cholecystogastric fistula affords the only escape for the static bile. To molest the fistula is to invite a biliary peritonitis. We have found that the prepyloric carcinoma effectively blocks the pyloric outlet so that the increased peristalsis merely forces the gastric contents through the fistulous tract into the gall bladder, thus inciting a fulminating cholangitis. By the use of a gastrojejunostomy the gastric obstruction can be partially overcome and the reflux of the irritating stomach contents into the gall bladder is thereby reduced. One of our patients lived for 6 months after such decompressive operation, free from biliary distress, only to die of coronary occlusion.

If the cholecystogastric fistula has been caused by the migration of gall stones, it is imperative that the functional status of the common bile duct be determined before the fistula is disturbed. Should these visualizing cholangiograms demonstrate incarcerated choledochal stones, which they all too frequently do, then the common duct is opened and the offending calculi are removed. Now that the choledochus is patent the gall bladder and the fistulous tract can be safely excised, provided the patient's condition warrants this additional surgery. In many instances the removal of the common duct stones still fails completely to remove the choledochal obstruction for the associated pancreatitis effectively occludes

the ampulla of Vater. Drainage of the common duct by indwelling catheters is then required. Should the gall bladder harbor calculi they are removed and drainage of this viscus is instituted. When postoperative cholangiograms reveal the choledochus to be patent, all catheters are removed (7). It has been interesting to observe that in many instances the cholecystogastric fistula has closed spontaneously. Removal of the gall bladder can be deferred until a more opportune time.

The management of cholecystoduodenal fistulas requires special consideration. If produced by a penetrating peptic ulcer several plans can be followed. Gray and Sharpe advocate gastric resection combined with cholecystectomy and excision of the fistulous tract. Garland and Brown advise a gastric resection without molesting the gall bladder or the fistula, stating that the abnormal fistulous tract will close spontaneously. We have found that the perforating peptic ulcers are usually so large and so close to the common bile duct that resection of the ulcer presents technical difficulties. Merely to remove the stomach does not relieve the concomitant choledochal obstruction and these patients are prone to die from hepatic insufficiency. It seems that the suppurative cholangitis aggravated by the associated choledochal obstruction presents the major problem (1).

Our plan has been to individualize each case after complete cholangiographic studies on the operating table are made. In the presence of choledochal obstruction, cholangitis, and impaired hepatic function the common bile duct is opened, offending calculi are removed, and catheter drainage is employed. The ulcer and fistula are not molested. Occasionally the excavating peptic ulcer may be so large that much of the duodenal content flows into the gall bladder. Thus a fulminating cholecystitis, cholangitis, and pancreatitis are incited. While it is desirable to resect such ulcers along with the stomach the technical difficulties which it presents seem insurmountable in these ill patients. Likewise, the sequestered inflammatory tissue around the base of the ulcer precludes closure of the fistulous tract without producing duodenal obstruction. Under such circumstances, prolonged drainage by means of a choledochotomy and cholecystostomy has relieved the jaundice and permitted the ulcer to heal. Remedial gastric resections can be deferred until the patient's condition improves.

Choledochoduodenal fistulas. The vast majority of choledochal-duodenal fistulas are produced by migrating choledochal stones or from penetrating peptic ulcers. Experience dictates that the

choledochus does not evacuate all of its calculi through the fistulous tract but some stones may remain in the common bile duct. These offending calculi may be wedged in the ampulla of Vater or incarcerated in the common bile duct above the fistulous orifice. In one instance we found the common bile duct to contain 12 stones and the fistulous tract was completely blocked by a matted calculus thus accounting for the patient's intense jaundice. Before the biliary tract is disturbed operative cholangiograms are employed to determine the number and position of the offending calculi (Fig. 3). A choledochotomy with removal of the obstructive stones invariably effects a cure. The fistulous tract is not molested, unless it harbors a stone for it invariably heals by the process of fibrosis. Usually the stone laden gall bladder is removed at this time.

Penetrating peptic ulcers on the posterior wall of the duodenum present a much different problem (Fig. 5). There is such an intense inflammatory reaction that the resulting fibrosis usually produces a permanent stricture of the common bile duct. In selected cases it seems wise to remove the ulcer and stomach and to transplant the resected choledochus into the jejunum. If the patient's condition precludes these extensive operations a cholecystogastrostomy or cholecystojejunostomy may suffice. Decompression of the obstructed common bile duct can be obtained by pulling a Levine tube from the stomach through the newly formed stoma so that its tip lies within the gall bladder lumen (8). Constant suction by the Wangenstein apparatus assures complete evacuation of the static bile. This procedure has been described by us in a previous publication (8).

Cholecystocolic fistulas. Cholecystocolic fistulas are difficult to handle because of the suppurative cholangitis and hepatitis incident to fecal contamination. The fistula usually communicates with the hepatic flexure of the colon and the inflammatory reaction surrounding the anus tract is so intense that the resulting mass may produce a partial or complete colonic obstruction. One has but to review the literature to become convinced that such patients do not survive a choledochotomy all in one stage. The primary consideration is to relieve the colonic obstruction and prevent reinfection of the biliary tract. This can be accomplished by an obstructive ileostomy which effectively shunts the fecal current. The distal loop provides an excellent channel for irrigating the ascending colon with effective

germicides which help to reduce the biliary tract infections. Sulfasuxidine will likewise reduce the bacterial flora of the intestinal tract and make subsequent operations safer. Under such conservative management the inflammatory reaction about the fistulous tract soon subsides, permitting the patient to drain into the colon thus relieving the jaundiced state. When the patient's condition permits the fistula can be excised and the offending gall bladder removed. Again, may we caution that it is essential to determine whether the common bile duct is patent if not, choledochotomy must be performed. Usually the pericolic inflammation will be minimal and the size of the fistulous orifice so small that it can be closed without resection of the large bowel. No attempt should be made to establish the continuity of the intestinal tract until the fistulous stoma is completely healed. While this necessitates multiple operations a living patient is a happy reward.

OBSERVATIONS

The best treatment for gastrointestinal biliary fistulas is prevention. This can be accomplished by removing gall stones before they have time to initiate such undesirable complications. Peptic ulcers which have not responded to conscientious medical therapy should be treated by gastric resection before they have had an opportunity to erode into the biliary tract. Early diagnosis of gastric malignant new-growths combined with radical surgical treatment can minimize these invasive complications.

There are several problems which must be considered in the surgical correction of gastrointestinal biliary fistulas. First these patients must be carefully prepared to withstand the added burdens of anesthesia and surgical trauma. Second the primary surgical consideration is to remove the obstructions of the common bile duct and institute drainage thereby alleviating the biliary stasis (1). Third corrective operations such as excision of the fistula, cholecystectomy or gastric resection can usually be deferred until the patient has made a good recovery from the decompressive operation on the bile ducts.

The mortality in the 13 operative cases was 30 per cent. In each of these 4 patients who died extensive remedial procedures were carried out at the initial operation. This convinced us of the wisdom of using multiple operations particularly that of employing decompression of the common bile duct as the primary procedure. Since following this plan there were 8 patients with internal biliary fistulas which were operated upon without

SURGERY GYNECOLOGY AND OBSTETRICS

SUMMARY

- 1 Spontaneous gastrointestinal biliary tract fistulas occur in approximately 4 per cent of all patients requiring surgical therapy for disorders of the biliary tract.
- 2 Gall stones, peptic ulcers, new-growths, and surgical trauma were the etiological agents in 272 studied. This includes 15 personal cases.
- 3 A preoperative diagnosis of gastrointestinal biliary fistulas cannot be made from clinical findings alone. Careful roentgenographic diagnosis affords the only method of making an accurate preoperative diagnosis. Characteristic roentgenographic findings in the various types of internal biliary fistulas are described.
- 4 Cholangiograms, performed on the operating table, afford an excellent method of visualizing the gall bladder, fistulous tract and entire biliary tree. Cholangiograms determine the location and ramifications of the fistula and clearly depict the size of its orifices. Cholangiograms permit accurate localization and differentiation of existing choledochal obstructions, whether caused by stones, strictures, pancreatitis, carcinoma, ulcers or periductal inflammation. Such visualizing roentgenograms provide the surgeon with an accurate blueprint of problems confronting him.
- 5 The principles of corrective surgery are discussed with particular emphasis on the value of multiple stage operations.

6 Thirteen patients were operated upon of whom 4 died. A mortality of 30 per cent. One patient having a cholecystoduodenal fistula was considered inoperable because of metastatic lesion to the lungs.

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RUPTURES OF MALARIAL SPLEENS UNASSOCIATED WITH EXTERNAL TRAUMA

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At this time and for some time to come the frequent occurrence of splenomegaly among our soldiers returning from the many parts of the world may be considered a pathological complication of World War II. Most of these large spleens are a secondary manifestation of malaria. As our soldiers return from the various theaters and suppressive at brine therapy is no longer required additional diagnoses of malaria will be made and more cases will be important but careful examination of the left upper quadrant will reveal splenomegaly in many cases, and this finding should make alert members of the profession to the potentiality of a higher incidence of spontaneous and traumatic rupture of the spleen. The enlarged spleen assumes greater surgical significance because it is more friable and fragile and also more vulnerable to trauma with resulting rupture and hemorrhage. This is emphasized in the report of Berger in 1902 where in 123 cases of traumatic rupture of the spleen 93 showed evidence of malaria.

More than 60 cases of apparent spontaneous rupture of the malarial spleen appear in the literature prior to 1895. None of these were operated upon, the diagnoses being made at autopsy. During the last 50 years, from 1895 to 1945 47 cases have been reported. For purposes of analysis, this has been divided into two 25 year periods namely 1895 to 1920 and 1920 to 1945. During the first 25 year period, which includes some of the early years in the development of abdominal surgery, 12 cases of spontaneous rupture of the malarial spleen were listed in a report by Leighton in 1921. We have undertaken to collect all the cases from the literature between 1920 and 1945 and are able to report 35 cases.

An analysis of the 12 cases in the period between 1895 and 1920 reveals 6 deaths a general mortality of 50 per cent. Five patients were not operated upon, the diagnoses being made at autopsy a mortality of 100 per cent. Seven patients were operated upon with 1 death—a mortality of 14.2 per cent. Of the patients

operated upon 3 were splenectomized without a death, and 2 were treated by tamponment with the death of 1 several days postoperatively from anuria. In the 2 other cases only exploration with removal of blood clots was carried out as the hemorrhage from the spleen had ceased.

An analysis of the 35 cases reported between 1920 and 1945 reveals 18 deaths, a general mortality of 51.4 per cent. Fourteen patients were not operated upon, the diagnoses being made at autopsy a mortality of 100 per cent. Twenty-one patients were operated upon and there were 4 deaths a mortality of 19 per cent. Of these 21 patients operated upon 19 were subjected to splenectomy with 3 deaths, a mortality rate of 15.7 per cent. Of the 2 other cases, one was treated by tamponment with recovery and the other was explored splenic fragments only removed, and death followed. Of the 35 cases, 9 patients had been inoculated with malaria for the treatment of lues and only 1 was diagnosed and subjected to successful splenectomy the other cases were diagnosed at autopsy.

The literature contains articles and case reports on spontaneous rupture of both the normal and pathological spleen. As to spontaneous ruptures of the normal spleen we are inclined to agree with Roettig, Nussbaum, and Curtis in doubting its occurrence and believe it should be placed in question. The case reports of Sussexman (7 cases) and Zuckerman and Jacoby (21 cases) lend some arguments in favor of the normal spleen rupturing spontaneously but probably a more accurate statement would be that such spleens may not have presented discernible signs of abnormality or pathology at the time of examination because the rupture occurred at the site of abnormality, destroying all evidence of previous pathology. The term "apparently normal spleen" might be more descriptive. The factor of internal strain or trauma is probably frequently associated with so called spontaneous rupture of the normal or pathological spleen. Such internal strain associated with muscular contractions or intra-abdominal pressure changes occurring with coughing sneezing yawning vomiting effort at the stool and other body exertions must be con-

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ordered. These academic factors may not be appreciated by the patient as far as their relation to his complaint of abdominal discomfort or pain is concerned. These are not unusual acts, and even the most minute questioning may not always extract the admission of their occurrence.

The onset of spontaneous rupture of the malarial spleen may be insidious and not present the picture of hemorrhage or shock in the early stages. To be alert to its possible occurrence in unsuspected situations will avoid many fatalities. Analysis and comparison of the two periods in the last 50 years reveal no improvement in the general mortality and this 50 per cent mortality is based mostly on failure of diagnosis. Certainly the technical phases of splenectomy have improved.

In the 3 cases reported in this paper a moderate degree of pain in the left upper quadrant, without a history of external trauma and without the classical signs of hemorrhage or shock, would not have resulted in early diagnoses and immediate successful surgical intervention if attending personnel had not been acquainted with the frequent occurrence of splenomegaly among military men and the possibility of spontaneous rupture of the malarial spleen.

CASE 1. J. V. Malaria was first diagnosed in this case about January, 1945, in New Guinea. He was treated with quinine, atabrine and plasmoquin and during the following months had two recurrent attacks. He returned to the U. S. States on rotation in November, 1944, and atabrine was discontinued. In January and March, 1945, he had recurrent attacks and was treated with atabrine. During the second attack in March, he went to sick call in the morning and fainted while waiting. He was admitted to the hospital, *Plasmodium vivax* was demonstrated and atabrine was started immediately. He complained of slight upper abdominal distress. During the afternoon of this day he began complaining of more abdominal distress and weakness. About 30 that evening, he collapsed while making an effort to the bathroom. He was again seen by a medical officer. There was increased upper abdominal pain and pain in the region of the left shoulder. The abdomen was distended and there was tenderness over left upper quadrant and lumbar areas. There was no fluid wave or shifting dullness. The blood pressure was 65/30, pulse 64, hemoglobin 9.5 grams. With plasma and blood transfusion, his general condition improved. Intramuscular atabrine therapy was started. The patient was operated upon under nitrous oxide gas-ether-oxygen anesthesia and the spleen was removed. The peritoneal cavity contained free blood and clots. There were three definite points of rupture on the convex margins of the spleen. He made an uneventful recovery.

Pathology: The spleen weighed 335 grams and was very friable. Serial sections showed small infarct. Microscopic examination showed focal necrosis of malpighian bodies. Malarial parasites were seen.

CASE 2. H. C. This patient developed malaria in the South Pacific in September, 1944. He continued on suppressive atabrine therapy until the day of admission to the hospital months later. For week prior to entering the

hospital, he had been constipated and had had no bowel movement. On this morning, he went to the toilet, strained severely and at this time noticed a sudden, rather severe pain just to the left of the epigastrium and under the left costal margin. Following this, he felt nauseated and retched several times. He felt little weak and returned to his bed to rest a little longer. In the afternoon, because of continued abdominal pain and marked distress in the region of the left shoulder, he entered the hospital.

Examination revealed a soldier in apparent distress. His abdomen was quite rigid, more so on the left, and there was marked tenderness in the epigastrium and beneath the left costal arch. The blood pressure was 100/54, hemoglobin 1 grams with 3.0, 0,000 red blood cells per cubic centimeter. Platelets were 140,000. Prothrombin time was 8 seconds for this patient and 7.5 for the control. In view of his history and the clinical findings, immediate operation was advised. Intramuscular atabrine therapy was started at once. On arriving in the operating room, his blood pressure dropped to 58/30 as he was moved from the cart to the operating table. Plasma was started immediately but he had been typed so blood was available in a few minutes and transfusion was given. The blood pressure returned to 90/60 and under nitrous oxide gas-ether-oxygen anesthesia, the spleen was removed through a transverse abdominal incision. When the peritoneal cavity was opened, a large amount of fresh and clotted blood was encountered. The spleen was palpated but no break in the capsule was found. Adhesions were very firm to the diaphragm. The splenic pedicle was gently exposed and a small vein, about 1 millimeter in diameter, was seen to be bleeding rather freely as a clot was lifted from this area. With the application of a clamp to the vein, bleeding stopped. No break in the splenic capsule could be ascertained before removal of the enlarged spleen. There were several areas of subcapsular hemorrhage. He made an uneventful recovery but a transfusion was given on the third postoperative day because of 9 grams hemoglobin and a 3 per cent hematocrit.

Pathology: The spleen weighed 370 grams. On microscopic section, the germinal centers of the hyperplastic malpighian bodies were partially necrotic. Occasional ring forms and schizonts of *Plasmodium vivax* were present in the erythrocytes.

CASE 3. C. B. This patient had his first attack of malaria in North Africa and remained free from recurrence as long as he continued to follow the suppressive atabrine therapy religiously. On several occasions, he omitted taking his daily tablet and within a matter of weeks he would have recurrent chills and fever. On one occasion when he had discontinued his therapy for some days, he had the opportunity and desire to eat an unusually heavy meal. That night he awakened about 1:00 a.m., felt nauseated, and induced vomiting by inserting a finger in his throat. While vomiting, he felt a severe, stabbing pain under the left costal margin and felt very weak on returning to his cot. He was unable to get much rest because of pain and the following morning reported for sick call. Because of pain and tenderness under the left costal arch, he was sent into the hospital. On examination, an enlarged and very tender spleen was palpated. There was tenderness in the epigastrium and left lumbar regions. Pulse was 94, systolic blood pressure 98, diastolic 64, hemoglobin 15 grams with 4,300,000 red blood cells. He had an attack of chills and fever soon after reaching his bed, and by this time positive malarial smear was reported. The patient remained very uncomfortable and stated that he felt something was pushing out his ribs. During the next 6 hours, his pulse increased to 120, the blood pressure dropped to 90/60. With the history of malaria and the large, very tender spleen with muscle rigidity more marked over

left rectus and lumbar regions without urological symptoms or positive urological findings by x-ray the diagnosis of a ruptured spleen was made and operation advised. Through a transverse incision the peritoneal cavity was opened. There was no evidence of free blood. The spleen was greatly enlarged and further exposure revealed a massive subcapsular hematoma. While manipulating the spleen for removal, the capsule ruptured and a large hematoma was partially released. At this moment the patient's general condition became rather poor; pulse became weak and blood pressure dropped. Plasma was started and he responded immediately. This was followed by whole blood, a donor having been selected before operation. No anesthetic was used. The pathologist reported a malarial spleen with parasites present.

Three types of rupture have been demonstrated in these cases—namely rupture of capsule with free bleeding; subcapsular rupture with massive hematoma development beneath the capsule and rupture of a vein in the splenic pedicle associated with several small subcapsular hematomas.

An analysis of these cases reveals that the patients began having rather sudden mild to moderately severe pain in the left upper quadrant with radiation varying to the epigastrium, left lower quadrant and lumbar regions. The onset may occur while the patient is apparently inactive or while making some slight exertion. Nausea or vomiting may be associated with this distress and there may be some feeling of weakness and a desire to rest and remain quiet. Two of these patients had a positive Kehr's sign with pain in the left shoulder to which one should attach great significance in a suspicious or known case of splenomegaly as it usually means leakage of blood beneath the left side of the diaphragm. Balance's sign with percussion dullness in the left upper quadrant is not so important as to indicate blood in this area because of the already enlarged spleen. However it is significant as to the presence of a large spleen and the possibility of spontaneous rupture. Tenderness and rigidity on the left side including epigastric and lumbar areas are most significant if there is a history of malaria. A history of overseas service with prolonged suppressive atabrine therapy should alert one to malaria even in the face of no history of chills and fever. Pulse, blood pressure and blood picture changes may not be present in these cases in the early period. With some of the typical picture of hemorrhage and shock in addition to a suspicion or knowledge of splenomegaly one can readily establish the diagnosis.

In the differential diagnosis, perforated or penetrating peptic ulcer ruptured gall bladder mesenteric thrombosis, volvulus, renal colic, diaphragmatic pleurisy pancreatitis and coronary

occlusion must be considered, but if the history can relate the heretofore mentioned facts regarding the possibility of malaria and splenomegaly, a prompt and probably correct diagnosis will be made immediately or after a few hours observation.

It is very advantageous in these cases that proper medical management be instituted immediately on diagnosis and, if possible, before the patient is operated upon. A chill occurring between the period of diagnosis and splenectomy may not only prove hazardous for the patient but embarrassing to the surgeon and the anesthetist. Anesthesia and surgery are both factors which tend to precipitate recrudescence of malaria. Strong in his text, cites Manson Baker reporting a reduction of red blood corpuscles by as much as one million per cubic millimeter with a single chill.

Quinine dihydrochloride by intravenous route has long been advocated for malarial crises because of the rapidity with which a high blood level is obtained. However Hudson has emphasized the fact that the peak level of quinine used intravenously is over within 30 minutes and that by large intramuscular doses of atabrine a quick more sustained therapeutic level is attained. An effective plasma concentration is reached within 15 minutes and maintained 6 hours by a 0.4 gram intramuscular dose. Consistent with this reasoning and in an attempt to avoid the depression associated with large, rapid doses of quinine atabrine dihydrochloride was selected for treatment in these cases. Upon diagnosis and before the patient was operated upon a 0.4 gram dose of atabrine dihydrochloride was given intramuscularly half of the dose into each buttock. Thereafter 0.2 gram were given intramuscularly every 8 hours until the patient could tolerate oral medication. Usually this occurs within 24 to 72 hours postoperatively and atabrine 0.1 gram is given three times daily for about 6 days or until 2.8 grams have been administered. Sodium bicarbonate was employed in 1 gram doses three times daily with the oral atabrine. Each patient was continued on suppressive atabrine therapy (0.1 gram daily) for a 30 day period following the emergency. In these cases, one or more transfusions of whole blood supplemented each operation. The rationale of this treatment is to prevent the occurrence of an inopportune chill before during or immediately following the operation to prevent or overcome the cachexia which occurs with the acute malarial attack and to prevent recrudescence of clinical malaria during the convalescent period.

The treatment is splenectomy and if tamponment and suture have no place in the fracture of the normal spleen, they certainly have no place in the management of the more friable malarial spleen.

SUMMARY

1 Splenomegaly is common among military personnel who have served overseas.

2 Apparent spontaneous rupture and traumatic rupture of the spleen will be more frequent because the enlarged spleen is more friable and more vulnerable to external trauma and internal strains.

3 The apparent spontaneous rupture of the spleen is probably associated with some form of unappreciated or unrecognized external trauma or internal strain.

4. A series of 12 and a series of 35 cases of spontaneous rupture of the spleen are reported.

5 Three additional cases with recovery following splenectomy are reported.

6. There has not been improvement in the general mortality rate for spontaneous rupture of the malarial spleen in the last 50 years. The figure remains at about 50 per cent and is based on failure of diagnosis or delayed diagnosis.

7 Splenectomy is indicated.

8 It is important to institute antimalarial therapy as soon as diagnosis is made and before operation if diagnosis has been made.

9 Atabrine is the drug of choice.

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EXPERIMENTAL SURGICAL PULMONARY COLLAPSE

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VARIOUS extrapleural stripping procedures have been introduced into the field of thoracic surgery since the initial report by Tuffier (95) in 1891. These procedures have all arisen as a result of a demand for a simplified operation which can be used in poor risk or complicated cases requiring collapse therapy. From a theoretical standpoint the operative procedure is sound in that relaxation in all directions can be secured by an extrapleural freeing of the lung just as in an intrapleural pneumothorax. Many present day surgeons combine an extrapleural dissection with thoracoplasty for the same reason and find no objection to a combination of operations (Semb).

Extrapleural pneumolysis as a primary procedure, however has met a great deal of criticism, more so in this country than abroad. The criticism appears to be based not so much on the operative approach to the problem as upon the frequency of complications which arise and because these complications are so difficult to manage. Extrapleural pneumolysis, unlike intrapleural pneumolysis, leads to the creation of a nonserous lined space with a distinctively different physiological reaction. The same end-results may be obtained in so far as collapse of the lung is concerned. Churchill (16-17) has stressed the fact that extrapleural pneumolysis, in contrast to intrapleural pneumothorax is an irreversible procedure and should be considered as such. In an attempt to make a reversible procedure out of an irreversible one, air was utilized to maintain the space and met with disrepute. The threat of infection was forever present and sooner or later the air had to be replaced by oil or the space had to be obliterated by a thoracoplasty (Dolley, Jones, and Skillen 18-19). Fundamentally then it can be said that the operation of extrapleural pneumolysis is sound but the methods of maintaining the space are unsatisfactory. With this consideration in mind experimental studies were begun in the Fall of 1943 to discover a material which could be used to fill an extrapleural pocket which would be nonirritating to the tissues, and which would permit the body fluids to organize forming a permanent fibrous pack. An ideal

material was found in methyl methacrylate commonly known by its trade name of lucite.

HISTORICAL

Extrapleural pneumolysis is not a new operation. The procedure was first described by Tuffier (95) in 1891. The first recorded operation in this country was performed by J. B. Murphy in 1898. In 1910 Tuffier (99) reported 3 cases and noted the need for some material to maintain the collapse. In 1914 (97) he reported 11 cases in which the cavity was filled with the patient's own fat. In this series there were 4 deaths and only 1 cure. Bull also used fat in 9 cases with healing in 5. Morrison Davies reported 4 cases improved by filling with fat. Fat was soon discarded as a filling material because it was too difficult to obtain in an emaciated person because it was too soft and because liquefaction occurred.

In 1913 Baer (?) recommended extrapleural pneumolysis because of its simplicity and because it avoided extensive skeletal operations. He employed a paraffin mixture, consisting of 75 cubic centimeters of paraffin with a melting point of 58 degrees centigrade and 25 cubic centimeters of paraffin with a melting point of 50 degrees centigrade plus 1 gram of bismuth carbonate and .05 gram of vioform. The paraffin mixture was sterilized by vapor sterilization on 2 successive days for 1 hour and warmed before using. The mixture hardened at body temperature and met the chemical requirements better than fat. Sauerbruch (79-80) was first to carry out a large series of cases with this material and Nissen (65-66-67-68) and his co-workers, pointed out indications and shortcomings of the paraffin pack. Complete obliteration of the pleural cavity is of prime necessity since the obliterating material causes a marked foreign body reaction which combined with gravity may result in a tear of the parietal pleura with penetration of the free pleural cavity. The same process leads to a necrosis of the lung overlying adjacent thin walled cavities. This most dreaded complication results in a severe infection and demands immediate removal of the pack. The pressure necrosis of the lung overlying thin walled cavities is attributed to the interruption of venous and arterial communications from the thoracic wall through the pleural adhesions.

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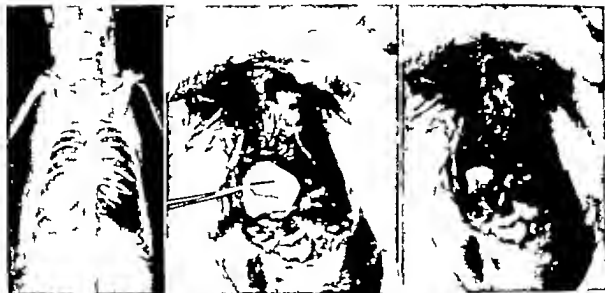


Fig 7 Roentgenogram of chest and uterine atrophy of rat No. 7 showing collapse of right lower and middle lobes 9 weeks

after insertion of methyl methacrylate mold into the pleural cavity

the blood supply from the lung to this area having already been interrupted by the cavitation. Too little attention has been given to the foreign body reaction created by paraffin. It is our opinion that this is of greater importance than the interference with the blood supply.

Baer (7,8,9) recommended performing the operation through an anterior incision. Nissen preferred a posterior approach and limited the mass to 500 or 600 cubic centimeters. Head has recently advocated the paraffin pack for closure of large apical cavities which are prone to retreat against the spine or mediastinum and remain patent despite extensive thoracoplasty procedures, including removal of the transverse processes and costal cartilages. He observed a higher percentage of favorable results than when thoracoplasty was performed as an initial operation. He also advocated the initial paraffin pack as a less dangerous procedure with a good chance of cavity closure. Furthermore he felt that thoracoplasty performed after initial paraffin packing was more apt to be effective and attended by less complications because of the reduction in size of the cavity and stabilization of the mediastinum. He reported 31 patients selected as being suitable for initial paraffin filling. Of these 31, 24 had conversion of sputum from positive to negative. Three were improved, 2 were worse and 2 died. Sixteen had large apical cavities, 6 of which were converted by packing alone and 7 others by packing and thoracoplasty. In 4 cases the paraffin perforated the lung and had to be removed.

Schlange, Sauerbruch (79,80) Casper and Matson (54,55) advocated compression with an extrapleural pack of plain gauze. Matson (54) in 1938 in a preliminary report advocated an extrapleural gauze pack in apical and subapical soft walled cavities of recent origin, preferably less than 4 to 5 centimeters in size with a patent bronchus. In general he employed the gauze pack in those cases in which extrapleural pneumothorax would at that time have been the logical procedure to utilize, that is, in those patients with tuberculous cavities or areas of infiltration in either one or both upper lung fields. The collapse was selective in character and he felt that the postoperative management was relatively simpler than extrapleural pneumothorax. Of 81 patients reported, 54 had conversion of the sputum, 15 were considered clinically well after the pack was removed. There were 4 deaths none directly attributed to the operation. Infection occurred with the formation of a purulent exudate in 18 cases and in 16 removal of the pack was necessary. Removal of the pack was followed by thoracoplasty in a large percentage of these cases.

Shivers, Archibald (4,5) Goffaerts and De Winter (34) Sebrechts, Alexander (2, 3) and Churchill (16, 17) have advocated filling an extrapleural cavity with pectoral muscle detached from the chest wall and humerus. The sternal and coracoid attachments were preserved with the main blood supply in order to diminish atrophy of the muscle. Archibald (4,5) Butler, Skinner, Douglass, and Merkel combined muscle packing



Fig. 2. Roentgenogram of chest and autopsy of rat No. 16 showing collapse of upper $\frac{1}{2}$ of right lung 8 weeks after

insertion of methyl methacrylate mold into the pleural cavity

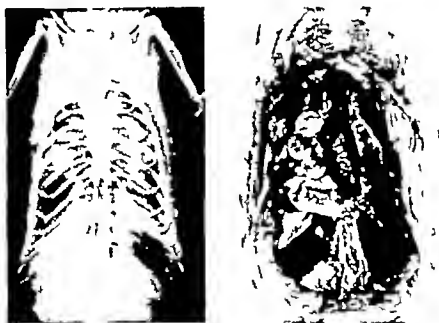


Fig. 3. Roentgenogram of chest and autopsy of rat No. 7 six months after insertion of $\frac{1}{4}$ inch methyl methacrylate balls into the pleural cavity. The balls are still free in the pleural cavity

with thoracoplasty removing the anterior portions of the second third and fourth ribs while Goffaerts and DeWinther performed an extrapleural pneumolysis through an anterior approach resecting a portion of the third rib and pulling the pectoral muscle through the first intercostal space. Alexander (3) and Lilienthal (51, 52) advised a supraperiosteal and subcostal filling of muscle performed through a curved

anterior incision in preference to an extrapleural packing. In this modification the periosteum of the first three or four ribs is stripped free and is displaced medially by the pack. Re-expansion is prevented by regeneration of the ribs in this location deep in the thorax. The advantages of this modification over extrapleural stripping is that there is less danger of tearing the pleura and the extent of the pulmonary collapse is readily



Fig. 4. Photomicrographs of the pleura and lung in contact with methyl methacrylate: a, left, weeks; b, 6 months. $\times 195$.

controlled by the amount of periosteal stripping and is not limited by the presence of tough extrapleural adhesions. The indications for supra-periosteal and subcostal packing are extremely limited. The limitations are much narrower than those of extrapleural pneumothorax and more closely approach anterior thoracoplasty in operative technique. With present day perfection of technique in performing thoracoplasty it is doubtful if any case of pulmonary tuberculosis is more suitable for this procedure.

Gwender, Jensen (46) Müller and Oughterson and Harvey (70) used an inflated rubber balloon inserted in the extrapleural space for the treatment of tuberculous pulmonary cavities. Haight, Harvey and Oughterson (40) used a similar balloon placed suprapariosteally for the treatment of nontuberculous cavities. This temporary collapse was maintained until the patient's condition permitted a thoracoplasty or an unroofing operation. Infection occurred in the majority of patients, and the postoperative management was complicated.

The maintenance of an extrapleural collapse by means of air refills is of relatively recent inception. Mayer in 1913 first demonstrated that it was possible to do a complete extrapleural stripping of the lung including the pleura over the diaphragm. Jensen (47,48) and Rieckenberg reported a series of successful cases. In 1933 Romanis and Riviere (74) reported an extensive extrapleural stripping with re-expansion because of delay in instituting the refills. In 1933 Jachia and Sebestyén advocated extrapleural pneumothorax in conjunction with an unsuccessful intrapleural pneumothorax. Serious attention was not given to extrapleural pneumothorax until the publications

of Graf (35,36) Schmidt (82,83) Moraldi, Nussen (65,66,67,68) Michelsson and Zorn between 1933 and 1938. In 1936 Graf (35,36) reported 107 cases with favorable results. In 1937 Schmidt (83) reported 155 cases and increased the number to 544 by May of 1939 (Adelberger, Thoms, Bellingier, Gaubatz, and Sauer). Large series of cases did not appear in the American literature until 1938 (Overholt and Tubbs, Belsey). At first received with considerable enthusiasm it immediately became apparent that air was not an ideal material for the maintenance of an extrapleural pocket. Unlike the serous lined intrapleural cavity the extrapleural space was maintained with difficulty, complications were frequent and re-expansion failed to occur following discontinuance of the refills. The space then had to be obliterated by thoracoplasty or converted to an oleothorax with its ever attendant danger. Dolley Jones and Skillen (18,19) in a comprehensive survey reviewed the results of over 277 cases gathered from 27 clinics where extrapleural pneumothorax had been in use for more than 2 years. The results varied with the character of the patients selected for operation. Conversion of the sputum occurred in only approximately 53 per cent of the patients and 11 per cent were dead. Early conversion of the pocket by means of oleothorax was advised in order to control and maintain the collapse, to reduce the expense of refills, and to minimize the chances of infection. On the whole the report was not favorable.

EXPERIMENTAL STUDIES

In the search for an ideal substance to be used as a packing material for an extrapleural space certain fundamental considerations were appar-



Fig. 5. Roentgenograms of chest of dogs showing a, collapse of apex, b, collapse of middle portion, and c,

collapse of lower lobe of the right lung by means of methyl methacrylate balls inserted into an extrapleural pocket.

ent. Since the material chosen was to be left in the extrapleural pocket permanently thus establishing an irreversible collapse comparable to thoracoplasty (1) the material should be non-irritating to the tissues, both in the immediate postoperative period and in later stages (2) it should be noncarcinogenic and nonantigenic (3) the material should be of light weight so that a large quantity could be introduced without danger of penetrating the pleural cavity and lung (4) it should be insoluble and not subject to chemical change in the tissues (5) it should offer little if any resistance to x rays (6) it should be capable of being premolded in such a shape that varying sized cavities could be filled through a relatively small incision.

The various metals and nonmetals which came under investigation included aluminum, tantalum, vitallium, preserved cartilage, stainless steel, celluloid and methyl methacrylate. The metals, especially tantalum and vitallium, were considered ideal in so far as the tissue reaction was concerned but were discarded because of the weight and expense. Celluloid and methyl methacrylate are both relatively inexpensive and light weight. Both have been used in orthopedic surgery and in neurosurgery to repair bone defects but nothing to our knowledge has been reported concerning their use in thoracic surgery. Celluloid was first used by Fraenkel in 1890 for the repair of cranial defects and gained wide popularity for this purpose in the early part of the century. Experimentally the tissue reaction has been shown to be slight. Immediately after the operation a serosanguineous exudate formed

about the celluloid which frequently required aspiration. Six days after implantation the celluloid was surrounded by granulation tissue containing newly formed vessels and polymorphonuclear leucocytes. After 4 weeks laminated connective tissue still infiltrated with inflammatory cells was present. Nev reported 300 implants with but 5 infections. If infection did not occur encapsulation took place. Several operators have found little reaction after several years. Funke (29, 30) however found that the celluloid lost its elasticity, became brittle and crumpled, and chemical analysis showed that camphor was lost from the implant. It has therefore been discarded.

Methyl methacrylate is an acrylic resin manufactured from acetone, hydrogen cyanide and methanol in the presence of sulfuric acid. The end product is a clear liquid called methyl methacrylate monomer. Under exacting chemical and physical conditions polymerization takes place giving rise to the clear solid form which is marketed commercially under the trade names of lucite, crystallite, plexiglass, and vitallite. In the finished form methyl methacrylate exhibits a tensile strength of 6,000 to 9,000 pounds per square inch. It is thermoplastic and softens when heated to temperatures above 220 degrees Fahrenheit (105 degrees centigrade). It absorbs only a small amount of water without changing its chemical composition. Methyl methacrylate is soluble in esters, ketones, ethylene dichloride and chloroform; it is not affected by weak acids or alkalis.

Methyl methacrylate was first used in dental prostheses and found to be nonirritating when in contact with the mucous membranes over a long



Fig. 6. a. Lung of dog No. 5 removed at autopsy 5 months after extrapleural packing with methyl methacrylate balls.

period of time. Kleinschmidt in January 1940 was the first to report its use in experimental animals, to repair skull defects. In the first few days the plate was found to be surrounded by a small amount of serum which rapidly organized, forming a definite capsule of hyaline connective tissue. There was little inflammatory reaction and no foreign body response even after the presence of infection. Kahn believed the material could be safely used at the time of a primary repair of a perforating wound of the skull, and even in the face of infection the plate need not be removed.

With these studies in mind, methyl methacrylate appeared to fulfill the qualifications of a satisfactory filling material to maintain an extrapleural collapse of the lung. Animal experiments were begun in November 1944 to determine the reaction of methyl methacrylate implanted into the extrapleural space and into the pleural cavity. Operation was performed on 30 adult rats and 10 dogs. In some of the rats collapse of the individual lobes was secured by implanting a mold of the lobe to be collapsed directly into the pleural cavity (Figs. 1 and 2). In other rats a portion or the entire pleural cavity was filled with $\frac{1}{4}$ inch balls introduced through a small opening in the chest wall (Fig. 3). The operation was performed with positive pressure anesthesia under sterile precautions. In the postoperative period frequent x-ray films of the lungs were taken. The rats were killed at intervals of from 10 days to 8 months and postmortem examinations were made. A little effusion was demonstrated following the introduction of the methyl methacrylate into the pleural cavity but the animals tolerated the material well and except for some shortness of breath in the first few days, activity was normal.

Histological studies of the pleura and underlying lung in contact with the implants showed (1) varying degrees of atelectasis of the lung (Fig. 4). In 16 rats atelectasis was present without inflammation. In 4 rats a pneumonic process was present with multiple small abscesses confined to the atelectatic portion of the lung. Empyema was associated with 2 of these cases. (2) A minimum of pleural reaction characterized in the first few days by the formation of a small amount of clear fluid around the implants accompanied by a swelling of the mesothelium and



b



c

Fig. 6. b. Photomicrograph of section through collapsed area of lung compared with normal lung. X85.

proliferation of the connective tissue in the submesothelial region. The mesothelial lining of the pleura remained intact in most instances and a few large eosinophilic staining cells resembling mast cells were observed in the submesothelial region. There was no round cell infiltration or giant cell formation (Fig 4).

In 18 of the rats the fluid around the implants became organized into a thin film of hyaline connective tissue infiltrated at the periphery with newly formed capillaries and a few chronic inflammatory cells. In 10 rats the implants were still free in the pleural cavity at the time of autopsy (Fig 4). Two rats died on the fourth and twelfth postoperative days and autopsy revealed empyema with the formation of abscesses and granulation tissue around the lucite balls and in the underlying lung tissue.

An extrapleural collapse was performed on 10 healthy dogs which were then followed clinically and roentgenographically for 6 to 8 months (Fig 5). Approach to the extrapleural space was easily secured between the ribs but because of the tissue paper character of the parietal pleura its close attachment to the periosteum of the ribs, and its extension high into the neck, classical extrapleural stripping in the dog was found to be extremely difficult. Dissection of the inner periosteum from the rib was frequently necessary. The space when developed, was filled with solid $\frac{3}{4}$ inch methyl methacrylate balls. In 8 of the 10 dogs a serosanguineous exudate appeared within 48 to 72 hours postoperatively resulting in moderate swelling of the operative site and requiring aspiration in 1 dog. Infection in the operative incision occurred in 1 dog requiring open drainage. Healing eventually occurred however with penicillin therapy and without removal of the lucite balls. There were no deaths in the series of 10 dogs and no evidence of any systemic reaction after the immediate postoperative period.

Autopsies revealed a localized atelectasis of the lung adjacent to the extrapleural pack (Fig 6). There was a moderate thickening of the mesothelial layer and microscopically some proliferation of the submesothelial connective tissue of the visceral pleura similar to that observed in the rats. Adhesions between the visceral and parietal pleura were absent in 7 of the dogs. In 3 fine string like adhesions were present. The methyl methacrylate balls in the extrapleural space were fixed in a dense mass of hyaline connective tissue (Fig 7).

EVALUATION

Methyl methacrylate introduced into the pleural cavity and extrapleural space of experi-



Fig 7 Photomicrograph of connective tissue surrounding the methyl methacrylate balls inserted into the extrapleural space. $\times 127$

mental animals is well tolerated. It is light weight, readily available, inexpensive and non irritating. Its reaction is characterized by the production of a thin capsule of hyaline connective tissue.

The adaptation of methyl methacrylate to clinical surgery is opening new horizons. At the present time it is being used to repair cranial defects and in reconstructive surgery. (10072) Our studies have been concerned with its adaptation to thoracic surgery. At the present time 8 patients with pulmonary tuberculosis have been operated upon. Methyl methacrylate has been used as a filling material to maintain an extrapleural collapse. The results in these cases have been sufficiently gratifying to warrant its continued use and will be discussed in a later paper. The use of this material we believe will save from discard an operation which has interested surgeons since the procedure was first described in 1891. It fulfills a need not satisfied by paraffin, muscle, fat, oil gauze or air. It adds to the surgeon's armamentarium a single stage procedure which because of its simplicity can be used in complicated and poor risk patients with pulmonary tuberculosis.

SUMMARY

Experimental studies utilizing methyl methacrylate implanted into the pleural cavity and extrapleural space of 40 laboratory animals have been presented. The reaction of the pleura and extrapleural tissue has been demonstrated. Its

THE RH FACTOR-SEROLOGIC BACKGROUND AND CLINICAL APPLICATION

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WHEN a foreign material such as, for example a disease-producing micro-organism enters the human body the latter is likely to respond with the formation of substances which destroy the invader. These substances, known as antibodies, usually function by agglutinating or by dissolving the foreign material. Antibodies may be absolutely specific in that they will attack only one particular antigen or toxin or micro-organism. Certain antibodies may be present in the body from birth so that the first invasion by the antigenic material is met by the already available defense force. This type of body reaction represents the process of immunization or if the antibodies are fully developed a state of immunity.

The antigen-antibody reaction which apparently is an attempt by nature to protect the body against noxious influences does not always proceed without damage to that body. If the total bulk of the affected foreign material or micro-organisms is sufficiently large, the agglutinating process within the bloodstream is apt to produce so much dead material in the form of coarse particles that capillaries may become obstructed and kidney function be impaired or if the dead material is broken down too rapidly a complicated systemic reaction to these "denatured" substances may set in manifested by chills, fever, flushing, chest and back pains, etc. If the foreign substance happens to be erythrocytes introduced with a transfusion of whole blood or of red cell resuspensions, there may be jaundice reflecting rapid destruction of the foreign red cells.

The so called A and B substances found either separately or together in the red blood cells of most human beings are in a sense antigens and they determine the four blood groups (A, B, AB, and O the last named being the group whose red cells contain neither of these two substances).¹ They are also called agglutinogens, because the

cells containing them are agglutinated (although they may be and frequently are hemolyzed i.e. dissolved) when brought into contact with agglutinins (antibodies) which are specific for the A or B substances and which are normally present in the serum of a part of the human race. Normally if an individual's red blood cells contain an agglutininogen his serum does not contain the corresponding agglutinin as there would then obviously occur destruction of the red cells within their own serum. That is to say anti A agglutinin is absent in individuals whose red blood cells contain A agglutininogen. The normally constant presence however of anti A agglutinin in the serum of a person with B cells renders that person a blood incompatible with that of an individual containing A (or AB) cells.

It is common knowledge that a transfusion reaction of severe type is practically inevitable if blood from a different group is introduced into the blood stream of any individual except one whose serum contains no agglutinins capable of destroying the injected red cells as it is this destruction of the foreign cells which almost invariably is the cause of the reaction. This is the reason we call an individual a "universal donor" ("blood group O") if his red cells contain no A or B agglutinogens so that the latter cannot be destroyed by pre-existing anti A or anti-B agglutinins in the serum of individuals receiving such a donor's blood. It is furthermore the reason we call an individual a "universal recipient" ("blood group AB") if his serum contains no anti A or anti B agglutinins, so that it cannot agglutinate or otherwise damage foreign red cells containing either A, B or A and B agglutinogens.

In pregnancy a mother may carry a fetus whose blood group will differ from hers because of inheritance from the father as father and mother do not, of course always represent the same group. One might therefore expect that the mother's already present anti A or anti B (or both) agglutinins would create havoc with the fetal red cells and red cell producing tissues, if the fetus has the corresponding agglutinogens within its cells, as such agglutinins readily pass through the walls of the placental villi which separate maternal and fetal blood. This actually does

¹From the Pathologic Laboratories, St. Mary Hospital, Dr. Bouton, director.

The A⁺ group includes subgroups (A₁, A₂, A₃) whose existence occasionally is responsible for so-called "intra group" incompatibility. These details do not contribute to this discussion and are therefore not considered further here.

occur, but only very rarely and the result may then be damage to the fetus in the form of "erythroblastosis foetalis," which may take the form—depending in part on the severity of the damage, in part on the organ or tissue chiefly affected in the infant, such as bone marrow or liver—of "hydrops foetalis," with death of the baby prior to or soon after delivery or of profound and progressive anemia, or of "icterus neonatorum" or possibly of a combination of these pathologic changes. (For purposes of didactic clarification only the familiar blood groups are invoked in this introductory discussion. More specific data follow.)

Almost all individuals are 'secretors,' that is to say, they possess the A or B substances not only in their red blood cells, but also—and actually in much greater concentration—in other tissue cells, and continue, moreover, to produce these substances in large amounts, so that they are even excreted in saliva and gastric juice (these fluids are the chief source of some commercially prepared A and B substances). When small amounts of anti-A or anti-B agglutinins are introduced into the bodies of 'secretors' gradually and by a route other than direct introduction into the circulatory system, they are readily neutralized or fixed by the abundant A or B agglutinogens within the body tissues before agglutination of the red blood cells, with their much weaker A or B concentrations, can occur. This is the reason why group incompatibilities of the A and B type between mother and fetus almost never occur. That is to say the red blood cells of secretors are surrounded, so to speak, by a defense wall which is breached, or rather circumvented only by the therapeutic device of intravenous administration of foreign blood in large quantity.

That trouble does to incompatibility of this type occurs at all is due to the fact that rare individuals are 'non-secretors,' that is to say they appear to possess A or B agglutinogens only in their red blood cells, which are thus exposed to the action of any anti-A or anti-B substance which may either through the placenta in the case of a fetus, or by transfusions in child or adult, get into the bloodstream. In other words, there is no available A or B substance elsewhere in the body to neutralize the anti-A or anti-B antibodies before they reach the red cells. In the fetus the effect may be erythroblastosis, in the recipient of a transfusion it may be a transfusion reaction.

The 'Rh factor' is an antigen which for all practical purposes may be considered to be entirely similar to the A and B substances, and, like these, it is also found within the red blood cells.

The two points of prime importance in considering the clinical problems related to this red blood cell factor are (1) that it exists only in the red blood cells that is to say *all individuals are non secretors* in regard to the Rh factor (2) that *there does not exist normally any anti-Rh antibody or agglutinin in human serum*.

The implications as to the first point are that any 'Rh-positive individual' (i.e. one whose red blood cells contain the Rh factor) is helplessly exposed to the destruction of his red cells if these are brought into contact with an anti-Rh agglutinin as his other tissues contain no Rh substance to neutralize such a specific agglutinin and thus to protect his red cells.

The implications as to the second point are that even though all Rh-positive individuals are nonsecretors, they are ordinarily in no danger at all as no normal individual has anti-Rh agglutinins in his blood. Consequently blood from both Rh positive and "Rh-negative (Rh-negative meaning simply absence of the Rh factor in the red blood cells by corollary group O blood might be termed AB-negative)" individuals can safely be given to Rh-positive or Rh negative individuals interchangeably with no risk whatever provided, of course, that donor and recipient are compatible as to their A and B groups. In other words, there is no need to consider Rh compatibility as far as *immediate danger* is concerned, in contrast to the situation as regards the A and B blood groups, and this fact explains also why ordinarily only the usual typing and cross matching procedures (for A and B substances) need be done to avoid transfusion reactions.

The Rh factor is dominant and follows the Mendelian laws of inheritance, that is to say in a mating of a genetically fully Rh-positive with an Rh-negative individual, the progeny will invariably be Rh positive. The Rh-positive progeny however may carry a "hidden" or recessive Rh-negative gene, and if such an individual is mated with an Rh negative individual, some of the progeny will be Rh-negative. An individual whose blood is Rh-positive and who carries only Rh-positive genes is "homozygot." An individual whose blood is Rh negative and who carries both Rh positive and Rh-negative genes is "heterozygot." If the blood of one partner in a mating, therefore, is Rh-positive and that of the other is Rh-negative the blood of the progeny will be either Rh positive in all children if the positive parent is homozygot, or in one half of all possible children if that parent is heterozygot.

In pregnancy there may be, and probably frequently is, some intermingling of maternal and

fetal blood through leaks in a traumatized placenta. In the case of an Rh negative woman carrying an Rh positive fetus such intermingling is at first quite unimportant in contrast to the situation of A or B incompatibility with a non-secretor fetus because the mother normally has no anti-Rh agglutinin with which to damage the fetal red blood cells. For this reason the first child in such matings is almost invariably normal, even if blood intermingling takes place in such an instance.

The introduction of Rh-positive red cells into Rh-negative blood will however initiate the production of anti-Rh antibodies so that prolonged or repeated contact of such blood with Rh positive red cells will eventually produce incompatibility. The latter will take the form of destruction of the Rh positive cells with resultant transfusion reaction on the part of the antibody-producing Rh-negative recipient of such cells, or damage to the fetus (e.g. erythroblastosis) in the case of antibodies formed by the Rh-negative mother entering the circulation of her Rh positive fetus, which as a non-secretor¹ in respect to its Rh factor cannot protect its red cells from the mother's antibodies by neutralizing the latter.

In other words, once sensitization of an Rh negative individual has occurred the status of that particular individual in regard to the Rh factor is the same as his or her status in regard to the A and B substances.

The initial lack of anti-Rh antibodies explains the fact that the first child in Rh-positive-Rh negative matings is normal and that transfusion reactions due to Rh incompatibility develop only gradually with only mild manifestations at first after repeated transfusions of Rh-positive blood into Rh negative individuals, and usually after a lapse of time necessary for the development of the anti-Rh antibodies. Of the white population about 87 per cent are Rh positive (negroes 92 to 95 per cent, Chinese and Japanese, 99 per cent). Actually the proportion of erythroblastic infants born of that population is considerably less than would be expected statistically because (1) there must (on the basis of existing knowledge) be direct contact between maternal and fetal blood to initiate development of anti Rh antibodies, presupposing placental leaks, (2) individuals differ in their ability to develop sufficiently large concentrations ("titers") of antibodies to cause damage (3) the relatively small number of women in our present population having more than one or two children naturally diminishes the likelihood of erythroblastosis.

On the other hand, the increased use of blood transfusions in present-day medical practice has increased the risk of sensitizing Rh-negative individuals by giving them Rh positive blood so that it occasionally happens that an Rh-negative woman will produce erythroblastosis in her first born because she received Rh positive transfusions previously, thus enabling her to develop anti Rh antibodies in preparation so to speak for her Rh positive child. Conversely if the husband of an Rh-negative woman is heterozygote the first 2 or 3 children may be Rh-negative so that the first Rh positive child, even though it represents the third or fourth pregnancy is just as safe as if it were the first born as there will have been no preceding antibody stimulation. Theoretically at least an Rh negative woman who as a child received intramuscular injections of Rh positive blood could conceivably be sensitized, but the likelihood of serious consequences of the form herein discussed is certainly remote.

An apparently complicating feature in the Rh picture is the more recently well established existence of several Rh types which may appear separately or in several combinations. This deserves mention in this connection only because the general medical literature occasionally refers to these subtypes by name, and because even if only in rare instances, it is possible for an Rh-positive woman to have an erythroblastic Rh positive infant on the basis of an Rh incompatibility. This would be because the father and mother happen to represent different Rh types, with the infant inheriting from the father an Rh factor absent in the mother's blood.

An additional complicating feature is the discovery of still another blood factor (more correctly red blood cell factor) which has been called the Hr factor in this country and is apparently identical with the St factor of British investigators. It is present (as determined to date) in the red blood cells of all Rh negative individuals as well as in those of individuals possessing certain of the Rh factors, that is to say about 75 per cent of the white population is Hr-positive (this includes the 13 per cent Rh negative portion as well as all Rh₁, Rh₂ and Rh types¹). The corresponding Hr antibody can contribute cases of incompatibility between Rh positive or Rh-negative fetus and Rh positive mother. Thus, it is necessary to know of this Hr factor and its antibody to avoid ignoring the possibility of incompatibilities when ordinary Rh

¹These last three are, of course, "Rh-positive"; see appended bibliography for terminology.

and anti-Rh testing seems to indicate freedom from danger.

To the ranks of Rh-positive—Rh-negative incompatibilities must therefore be added those occurring among Rh subtypes: the Hr positive—Hr-negative combinations; antibody action on nonsecretors in the regular Landsteiner groups, and so far not mentioned those relating to the M, N and P factors, the latter three long known in paternity testing but otherwise hardly of significance clinically.

The A and B nonsecretors, however chiefly of theoretical interest, were discussed earlier in this report only to furnish a more readily comprehensible groundwork for the discussion of the Rh and related problems. From the point of view of frequency incompatibilities induced by pregnancy or multiple transfusions remain chiefly an Rh positive—Rh-negative problem. Actually over 90 per cent of all cases of infant erythroblastosis occur with Rh-negative mothers, with the remaining less than 10 per cent of cases distributed among all the other aforementioned incompatibilities, and within this last-named minor group the Hr factor is probably responsible for the majority of cases.

Laboratory procedures for determining the Rh factors and their antibodies are similar to those long in use in determining standard blood groups, but are more difficult to perform and thus are subject to misinterpretation. A frequent error in many typing laboratories is the reporting of an Rh-positive individual as Rh negative, as many improperly controlled sources of such reports still use commercially advertised typing serum of animal origin which has the triple faults of (1) not reacting to all Rh types, (2) reacting poorly in most or many instances in which it should produce readable reactions and thus causing false negative readings, and (3) of producing false positive reactions in Rh negative infants. Aside from the last named occurrence no anti Rh typing serum should, theoretically ever give a false positive reading in a properly conducted test.

Many surprisingly weak reactions *in vitro* obtained from blood of women bearing markedly erythroblastic infants, and many false negative reactions in tests for anti-Rh antibodies have been explained by the concept of so called "blocking antibodies" (or "incomplete antibodies"), meaning substances in the serum to be tested which attach themselves to Rh-positive red cells (or more correctly to the Rh factor in those red cells) without causing agglutination thus preventing ordinary agglutinating antibodies from

producing a visible reaction. It is now becoming apparent that such blocking antibodies run parallel and may be identical with the anti-Rh antibodies which destroy Rh-positive red cells *in vivo* and that this test tube phenomenon may reflect artificial differences between reactions occurring within the bloodstream and those observed in the laboratory. This should also serve to explain at least in part why the customary "cross-matching" procedures for the regular blood groups were done these many years without discovery of the Rh factor and its antibody. Such differences are further indicated by the fact that the test tube reaction upon which we rely almost entirely in determining the Rh status is agglutination, whereas the reaction within the human body appears to be almost entirely one of hemolysis or at least of a combination of these two processes. Another potential source of confusion is the fact that Rh antibodies appear to react best at body temperature, i.e. they are "warm agglutinins," in contrast to anti-A and anti-B antibodies, which are cold agglutinins. Recently developed modifications of testing methods have largely overcome these handicaps, and Rh typing is now an adequately sensitive and dependable test with the right reagents and in trained hands.¹

A so called "biologic test" has been described and recommended, consisting of the introduction of a small amount of Rh-positive blood (e.g. 50 c.c.) into the circulation of an Rh-negative individual with testing of the latter's serum for evidence of subsequent hemolysis as an index of the presence of antibodies, but this procedure is considered by the writer to be reprehensible and at this time unjustified as it obviously tends to stimulate antibody production where there was none before. It is well established that minute amounts of Rh-positive red blood cells (such as are assumed, for example, to escape into maternal blood through damaged placental villi) may suffice to stimulate such a reaction.

The only good sources of spontaneously occurring dependable anti-Rh typing serum at present available are women who have recently given birth to erythroblastic infants, and, much more rarely, Rh negative individuals who have reacted to multiple Rh-positive transfusions. Such women should therefore, if healthy, be urged to contribute blood while their antibody titer is high and can be paid for such donations at the usual rates, as the Blood Grouping Labora-

¹The appended bibliography. It is essential, in this writer's opinion, that any laboratory or blood bank worker who performs anti-Rh typing read the papers dealing with these recent modifications of the test, as they represent a radical improvement over the original technique in the direction of both simplification and dependability.

tones in Boston (Dr. Diamond) will on receipt of such blood credit the sender with typing serum in proportionate amounts.

New sources of high titer typing substance in probably ample amount are now available obtained by fractionating serum from Rh-negative individuals with artificially stimulated anti Rh antibody production. This procedure is the same as, or similar in principle to that previously in effect for the production of high titer anti-A and anti B substances.

Rh-negative donors should of course be available through hospital lists for transfusions. It goes without saying that their standard blood groups must be established as well. Such lists cannot, however include women who have given birth to erythroblastic infants as their blood is apt to contain some anti Rh antibodies at all times.

In view of the comparative scarcity of dependable anti-Rh typing serum to date as well as of the fairly well established scope of the Rh problem in medical practice, it is at present neither desirable nor necessary to type every patient routinely for this factor. It is however proper that typing for the Rh factor be done prior to transfusions, in any female patient before and within the child-bearing age, in all pregnant women, in any postmenopausal woman with a history of having borne erythroblastic infants, and in any individual, male or female, who is to receive multiple transfusions over an extended period.

If a hospital patient is found to be Rh-negative, and if there is a history of previous unexplained transfusion reactions or of erythroblastic progeny the blood should automatically be examined also for anti-Rh antibodies. If a patient is Rh positive but if there is clinical ground for suspicion of blood incompatibility—as for example in a pregnant woman with a history of abnormal deliveries¹—her blood as well as that of the husband may be sent to Dr. Philip Levine or to Dr. Diamond for Rh subtyping and Hr typing at least until such time as hospitals generally may have available the necessary testing materials for determining Rh subtypes, Hr bodies, etc. in their own laboratories.

If anti Rh antibodies are found in a pregnant woman the physician should be notified and may then consider prophylactic procedures such as premature induction of labor or cesarean section.

¹The term abnormal deliveries should not include here miscarriages, such as anencephalics, as both embryologically and on the basis of clinical experience Rh incompatibilities cannot be incriminated for such conditions. This applies also to the relatively frequent miscarriages early in pregnancy.

In addition preparations should be made in advance of delivery for immediate checking of the infant's blood and clinical status with consideration of immediate transfusions of Rh negative blood, not from the mother. With such a treatment plan an anatomically normal-appearing infant, even if jaundiced at birth should recover completely. The chief risk is central nervous system damage from prolonged kernicterus i.e. jaundice of the cerebral basal nuclei but such risk is slight if jaundice is not permitted to become profound or to persist over a long period.

If a woman whose Rh status has not been previously determined is delivered of an infant which is jaundiced or edematous or unusually pale, and if the physician wishes to prove or rule out erythroblastosis due to a blood incompatibility without delay and with the fewest laboratory procedures, he should order a blood smear study on the baby (differential count) if this reveals erythroblastosis preparations for transfusions of nonmaternal Rh negative blood should automatically begin, with simultaneous determination of the baby's Rh and the mother's anti Rh status the latter tests to be done at that time chiefly to avoid the unlikely but possible accident of giving Rh negative and thus Hr-positive blood to an Rh negative baby carrying maternal anti Hr antibodies. When possible the placenta should be saved in all such cases for pathologic study.

There has been some published controversy as to the merits of giving erythroblastic infants Rh positive blood, on the assumption that the anti Rh antibodies transmitted by the mother to the infant might be more rapidly neutralized by the additional Rh-positive red cells. Even if this be granted (disregarding the clinical impression that such antibodies within the infant frequently are not free for complete neutralization at any one time, but are somehow "bound" and are released only gradually to act on the infant's red cells) it should be kept in mind that the neutralizing of such antibodies is taking place within the living infant, not in a test tube and that it represents a wholesale destruction of red cells within the body without substitution of non-affected red cells, so that an additional burden is placed on an already damaged liver as well as indirectly upon other tissues in the form, at least in part, of anemic anoxia. It would therefore seem more sound physiologically merely to replace the infant's own destroyed Rh-positive cells with indestructible Rh negative cells until the remaining maternal antibodies have diminished to the point of harmlessness, which will inevitably

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be the case within a few weeks postpartum and usually occurs long before that. Obviously the older the baby the safer the infusion of Rh-positive red cells will be assuming there is still need for transfusions to combat a lingering anemia (due to delayed recovery of the baby's longer in evidence).

Lacking Rh-negative donors, the mother's Rh negative red cells may be infused into the infant after they have been separated from their serum and are resuspended in saline as the maternal anti-Rh antibodies exist only of course in the serum and can be eliminated by such separation. The father's blood is obviously not suited, as it is factors inherited from the father which are in the first place responsible for the damage to the infant.

Attention is called to the possibility of increased danger of hemorrhagic damage to an erythroblastic fetus during prematurely induced labor. Whether this represents an actual hazard in practice remains to be seen but it must be considered in weighing the relative merits of labor induction versus cesarean section.

The practicing physician's greatest problem is that of advice to Rh incompatible parents. He must first assemble and evaluate all pertinent data, i.e., past clinical and laboratory evidence if available, of the mother's "antibody potential as reflected in antibody titer and severity of damage to previous offspring and the possibility that the husband may be heterozygote. The latter information can usually be obtained in such cases, as it will be remembered that there appears to be a definite relationship between occurrence of the Hr factor and the absence of any or presence of heterozygote Rh factors in the blood, which makes it possible to attempt laboratory determination of heterozygote individuals by the combined use of anti Hr and specific anti-Rh sera. Rh typing of the husband's parents and siblings or of previous children if there are several, may permit determination of heterozygosity make-up of the husband without recourse to Dr Diamond's laboratory, as, for example, one Rh-negative sibling of the husband or one Rh-negative child is sufficient to prove such status.

Advice to parents may include warning against becoming pregnant immediately following delivery of an erythroblastic infant (to permit antibody level in the mother to subside) and should include urgent suggestion for prenatal

antibody checking and possibly psychological preparation for cesarean section or premature induction of labor. It is furthermore essential that the mother refrain from nursing an erythroblastic child, as her milk will contain the antibodies responsible for the infant's disease. On the other hand, if the husband is heterozygote or the woman a antibody potential appears to be low, the possibility of entirely normal children should be kept in mind by the physician and should be explained to the parents in advance, so that the latter will not lose confidence in the advancing physician because of apparent discrepancies between his expressed fears and their experience. The event of an entirely normal pregnancy following discussion of their problem.

To compensate for the superficial consideration in this discussion of the technical and scientific (specifically genetic) details on which this subject is based, the appended list of selected original reports is recommended as representing complete and authoritative information, beyond the needs of the practicing physician but obligatory reading for a complete blood bank or responsible laboratory.

NOTE. Additional experience since this paper was written (Ayimma, 1945) has confirmed my opinion that it is not good practice to give more than very small amounts of fluids intravenously to premature infants. If fluids are required, subcutaneous administration probably comes with it the least danger of cardiovascular embarrassment. This practice deserves mention here because of the tendency in some quarters to give blood "prophylactically" to infants in whom erythroblastosis has not been demonstrated, but in whom its possible development is anticipated. If labor has been induced or cesarean section performed prematurely on the basis of high and rising antibody titer in the mother the prematurity of the infant must be considered as a deterring factor when intravenous fluid administration, especially of whole blood, is contemplated. If there is evidence of already developing erythroblastosis, the condition of already developing treated red cell suspension in saline intravenously and of plasma substitution (the latter of course, as non-specific supportive therapy and provider of plasma proteins) is recommended.

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JUNE, 1946

"INFLAMED AND INJURED TISSUES NEED REST

TODAY when so much emphasis is being placed upon the ambulatory treatment of fractures of the lower extremity and upon early rising after abdominal operations after operations for hernia and after childbirth it may be worth while to recall some of the principles of Hunter of Hilton and of Hugh Owen Thomas and their insistence upon the importance of rest in wound healing.

The names of John Hunter and his older brother William are familiar to every medical student that of Hilton probably much less so. John Hilton (1807-1878) began the study of medicine at Guy's Hospital when only 17 received his diploma at the age of 21 and then entered the dissecting room as demonstrator of anatomy. For 17 years he worked in the dissecting room and postmortem room before he was appointed at the age of 38 assistant surgeon to the hospital and lecturer on anat-

omy. In 1863 after the completion of a series of lectures before the Royal College of Surgeons he published these lectures in a small volume *Rest and Pain* which exerted a profound influence both on his contemporaries and on succeeding generations of surgeons on no one more than on his admirer Hugh Owen Thomas. His essential philosophy he expressed very clearly at the close of his fourth lecture.

"By regarding this subject of physiological and mechanical Rest in what I conceive to be its proper professional light, the surgeon will be compelled to admit that he has no power to repair directly any injury. It will induce him to acknowledge, in all his milky that it is the prerogative of Nature alone to repair the waste of any structure. He will thus realize that his chief duty consists in ascertaining and removing those impediments which obstruct the reparative process, or thwart the efforts of Nature, and thus enable her to restore the parts to their normal condition.

To secure the rest which he considered of fundamental importance in wound healing (as of course did John Hunter and many others before him) he constantly drew upon the extensive anatomical knowledge acquired during his long years of apprenticeship in the dissecting room. His emphasis upon the importance of pain as an indication both to diagnosis and to treatment, and his method of providing rest for inflamed tissue are pointedly brought out in his discussion on inflamed joints in Chapter VII.

I may remind you that when a joint becomes inflamed it is painful and difficult of movement it becomes involuntarily fixed by Nature's own process, thus securing comparative rest to the interior of the joint. Indeed we may lay it down as an axiom that Nature instinctively renders an inflamed joint comparatively fixed and flexed.

Rest and Pain. Course of Lectures on the Influence of Mechanical and Physiological Rest in the Treatment of Accidents and Surgical Diseases, and the Diagnostic Value of Pain. By the late John Hilton, F.R.S., F.R.C.S. edited by W. H. A. Jacobson, M.A., M.B., M.Ch. (Oxon.) F.R.C.S. London: G. Bell and Sons, Ltd., 1934.

SURGERY GYNECOLOGY AND OBSTETRICS

He goes on to describe the innervation of joint and surrounding muscles that permits and brings about the rigid muscle contractions that immobilize and protect the affected joint. The obvious corollary is the careful splinting that provides a substitute and relief for the contracted muscles and permits the painful spasm to subside and still insure the needed rest.

The same principle of relief of painful and spastic muscle contraction resulting from inflammation of surrounding tissue is exemplified by many types of cases—fractured bones suppurating joints osteomyelitis nerve injuries rectal and anal ulceration, etc. etc. A somewhat broader application of the principle of rest that carries its own connotations is his amusing account of a patient with a chest injury (Lecture V.I)

A physician, residing not very far from me had under his care a patient who had received a blow upon his chest by a fall upon the part and as he was, after several days, still suffering a good deal of pain in breathing the physician asked me to see him in reference to the possibility of fractured ribs. I could find no fracture but I observed that the patient had a most worrying wife. She was incessantly talking to him day and night, and there were continual tensions between them upon domestic affairs. I suggested to the physician that the sole cause of the pain was, in all probability the sole cause of the constantly moving the injured or bruised soft parts by using his chest and lungs in speaking. All I recommended was, that he should hold his tongue, and have his chest bandaged. I requested that his wife would not say a word to him, but would provide him with a slate and pencil so that he might write down all his desires. From that time he got quickly well by local rest.

One believes that Weir Mitchell would have approved of this treatment.

Perhaps better known to the surgeon of today than Hilton is his follower and admirer that doughty little man with peaked cap and ever present cigarette to whom every worker in the field of bone and joint surgery is so greatly indebted Hugh Owen Thomas (1834-1891) Thomas went still further than Hilton

in his insistence on enforced uninterrupted and prolonged rest.

His message to the surgeons of his time was that they did not understand the meaning of the word rest. Hilton he said fixed a limb in a splint, and believed he had given it rest. Immobilization he held to be the first requisite but it must be applied in such a way that the diseased part was not compressed, nor the normal circulation of the limb in any way interfered with. All forms of plaster-splint accumbent and several others he abandoned them at an early stage of his practice. Pressure he held, was a form of restlessness or irritation. If he applied a stiff or elastic bandage to a diseased knee joint, so as to compress and surround it, he held that in so far as he lessened the movement of the joint he assisted repair but in so far as he compressed it he hindered repair until all trace of unsoundness had disappeared from the joint and then that point being reached, the cure would be completed by the gradual return of natural voluntary movements.

Keith in his delightful chapter on "The Principles and Practice of H. O. Thomas in *Masters of the Maimed*" goes on to cite his application of the principle of rest in a condition with which we rarely connect the name of Thomas—obstruction of the bowel

"The treatment of the case I have selected for an example has been placed on record by his nephew Sir Robert Jones.

"I remember well how Mr. Thomas called the relatives together and told them he was going to make a fight for the patient's life. He urged them to be loyal and to help him and to add to his persuasion, he threatened them with a coroner's inquest if they gave the patient anything without express permission. Above all things the patient was to have no milk the foot of the bed was to be elevated to lessen the pressure in the abdomen a morphia injection was given and nothing but sips of water with a little arrowroot. For the first few days he visited the patient five or six times a day. Almost immediately the vomiting was reduced to about once in twenty-four hours the patient became easy and slept, but the abdomen was tense. Twice he performed paracentesis (for the relief of pressure) being careful not to allow the trocar to remain in the intestine longer than a few minutes, for fear of a fistula. On the twenty-fourth day at intervals, a very little fat was passed on the twenty-sixth large quantities, and

Masters of the Maimed, the Anatomical and Physiological Principles Underlying the Treatment of Injuries to Muscles, Nerves, Bones, and Joints by Arthur Keith, M.D. (Abern.), F.R.C.S. (Edn.), and Abner H. H. London: Henry Frowde; Hodder & Stoughton; Grafton University Press, 1919

later in the day a few small scybala. Again during the night a copious pulsatious motion and this again followed for three days by prodigious quantities of thin faecal fluid.

From the method in which that case was treated we see that rest was to be applied with the meticulous care and rigidity of a Calvinistic doctrine. Rest was to be secured first by sedatives—to place the bowel at ease and relieve pain the bowel was to be restrained from all manner of work by absolute starvation he declared he had never seen starvation cause death in a case of intestinal obstruction however prolonged. The bowel was not to be disturbed by any act whatsoever such as the giving of enemata or 'rectum tickling' as he most unprofessionally phrased the practice. 'Nature,' he said 'is late in working a relief and patience is needed. His critics said his treatment of intestinal obstruction was not new and modern surgeons will declare it to be bad. His medical critics, however were wrong opium and starvation had been often prescribed and employed in such cases rest had been enjoined but Thomas was the first to apply rigidly and completely the principle of rest as a logical system to such conditions, and to carry it out in the form of enforced uninterrupted, and prolonged rest.

Many illustrations of the emphasis on rest in modern therapy can be quickly called to mind. The treatment of tuberculosis by rest of the body and rest of the involved lung is the very basis of modern therapy. Wangenstein, Miller and Abbott introduced an effective method of combatting intestinal obstruction that exemplifies the principles Thomas stressed so clearly. Orr applied the teachings of Hilton and Thomas to the care of osteomyelitis and gave a new meaning to the words 'enforced uninterrupted and prolonged rest.' More recently Dragstedt has applied the principle to the treatment of inflamed and ulcerated gastric and duodenal mucosa by removing the irritating influence of excessive gastric secretion through division of the vagi.

Accurate and painstaking as were the experimental observations of Hunter the studies of Hunter and Hilton in dissecting room and post mortem room and the clinical observations of all three men neither Hunter nor Hilton nor Thomas had the opportunity of following the process of wound healing by microscopic studies of tissue from experimentally produced

wounds. It is of interest then to note that in reports of such studies by many workers (Harvey, Howes, Mason and Allen, and others) the lag period of wound healing is constantly emphasized and the fact that during this initial period of from 4 to 6 days the strength of the wound depends solely upon the suture material used. Mason and Allen¹ have shown that in the case of sutured tendons the tendon ends become swollen, soft, almost gelatinous and that tension applied during this early period can result only in cutting through of suture material and separation of tendon ends. Howes and Harvey² have stated:

From this study one is able to say that fibroplasia starts abruptly at the fourth day and proceeds with decreasing velocity until a maximal strength for this phase of healing is reached around the twelfth to the fourteenth day and that by the sixth approximately one third and by the eighth approximately two thirds of this strength is obtained. This, of course, is readily checked against and correlates with surgical experience. This phase of fibroplasia has been studied in wounds of all tissues in which the normal tensile strength is greater than the maximum of the fibroplastic process and the velocity curves of fibroplasia are identical in type.

The fact that at a later period during the process of healing physiologic tension and activity provide a helpful stimulus to sound healing of soft tissues of tendon and of bone was well recognized by Hunter, by Hilton and Thomas and again has been confirmed by many well controlled experimental studies. Until time has elapsed for fibroplasia to be gone—and its beginning will be influenced as Howes has stated 'by careful surgical technique with the minimizing of infection and contamination in the wound and with the insertion of small amounts of suture material'—the 'injured and inflamed tissues need rest. It is obviously not the answer to every problem. It is a principle of wide application and of far reaching importance. SUMNER L. KOCH

¹Mason, M. L. and Allen, H. S. The rate of healing of tendons. *Ann. Surg.* 94: 33 412-420.
²Howes, K. L. and Harvey, B. C. The clinical significance of experimental studies in wound healing. *Ann. Surg.* 91: 91 941-946.

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

WE are happy to welcome the *Journal of the History of Medicine and Allied Sciences* to the company of surgical and medical journals. The motive for this journal and its purpose are so clearly set forth by Editor George Rosen that we repeat a few sentences in introductory pages that we repeat a few sentences in human development. Every situation that man has faced and every problem that he has had to solve have been the product of historical developments and processes.

To understand our own society and to be capable of playing an intelligent rôle in shaping our own civilization, we must have knowledge of the actions of the past.

During the past seventy five years a large part of the medical profession has turned away from the history of medicine. We sincerely believe that this trend has resulted in a serious loss for a profession which by implication approach each time it writes or speaks of the case history. In part, also, the onus for this trend may be attributed to medical historians who were not always able to make medical history the living, dynamic thing that we believe it to be. We do not want to cultivate medical history as a mere search for antiquities, as a kind of hunt for curios, but rather as a vital integral part of medicine.

No one would have agreed more whole heartedly with Dr. Rosen than Oiler Welch, Cushing and Cutter—men to whom the memories and achievements of the great doctors of the past were living and integral parts of our heritage and our present day attainments.

A partial list of the table of contents of the first number will give the reader a clue as to the scope of the new journal. Some Galenic and animal sources of Vesalius the London years of Benjamin Waterhouse a note on William Blake and John Hunter pharmacopoeias as witnesses of world history the two earliest dentistry woodcuts, Bernardino Mon-taña de Monerrate education in 17th century Spain.

The editors of *SURGERY GYNECOLOGY AND OBSTETRICS* extend best wishes to the new journal and high hopes for its success.

The Manual of Surgical Anatomy by Tom Jones and Willard Shepard was prepared under the auspices of the Committee on Surgery of the

Division of Medical Sciences of the National Research Council. It is one of a series developed by the States Army and Navy with compact presentation of necessary information in the field of military surgery.

The objectives are plainly set forth in the foreword. According to Major General Kirk, in the surgery of trauma great demands are made upon the surgeon's knowledge of anatomy, in the treatment of traumatic injuries under the exigent conditions of war a concise atlas of applied anatomy is required to permit "a rapid visual review of any part of the body and the proper surgical approaches to the various regions."

In a second foreword Vice Admiral McIntire commends the artists for the preparation of "line drawings which for accuracy and simplicity may be considered unsurpassed. These comments and commendation record the chief characteristics and the successful nature of the *Manual*, they merely require elaboration.

The figures are arranged in the following order, and with the indicated coverage in pages: head and neck (33 pages) thorax, abdomen, and pelvis (49) upper extremity (40) lower extremity (30). The section on Illustrations is followed by a 35 page explanatory index, which is essentially a glossary of names many of them and structures pictured, but legends. Many of the figures are executed in such a way that surgically important deep structures are projected (usually in color) in relation to superficial, palpable landmarks. For example, in purely anatomical pictures, cerebral ventricles, dural venous sinuses and tributary veins are shown in interrelationship and in their relationship to cerebral gyri and to bones of the skull accessory air sinuses and salivary glands in relationship to regions of the face palmar synovial sheaths, to skeleton and to surface markings vessels and nerves, to bones of the extremities. In anatomoclinical illustrations, the body are grouped in sets for the major divisions of the body the same very serviceable scheme is employed on even more ambitious scale. In the plate depicting pericardotomy, for example, the series begins with transverse section showing the anatomical route of approach to the heart this is followed by one recording skin and muscle incisions in relation to the costal cartilages another to expose costal cartilages then, successively picture, pericardium and heart with coronary vessels. Thoracotomy, sympathectomy laparotomy lumbar sympathectomy block arthroplasties for all major joints synovectomy

The Manual of Surgical Anatomy by Tom Jones and Willard Shepard was prepared under the auspices of the Committee on Surgery of the

JOURNAL OF THE HISTORY OF MEDICINE AND ALLIED SCIENCES. NEW YORK: HENRY SCHENCK, 1941. A MANUAL OF SURGICAL ANATOMY. Prepared under the auspices of the Committee on Surgery of the Division of Medical Sciences of the National Research Council. By Tom Jones and W. C. Shepard. Philadelphia and London: W. B. Saunders Co., 1941.

to all long bones commonly involved in fractures are illustrated with equal ingenuity. Ingenuity & hand made economy is here an able supporter. Surface landmarks, topographical succession in transected part, and structures serially encountered in the incisional route are almost invariably shown in a single plate of multiple figures with carefully selected labelling of crucial elements and in a pattern of arrangement reflecting the best in artistic taste and the highest in pedagogic value.

All drawings were done with the line technique. They are uniform, strikingly clear and invariably crucial.

It is earnestly to be hoped that when the needs of the Army and Navy have been met, the book will be made available for regular commercial sale to medical schools. The undersigned would encourage his own students to purchase this excellent manual.

BARRY ANSON

THE two volumes entitled *Clinical Cystoscopy* by Lowman E. McCrea can be recommended without reservation to everyone interested in urology. The make-up of the books is exceptionally well done. The type is large and easy to read, the paper is of unusually good quality with a glossy surface that reproduces very well the photomicrographs, drawings, diagrams, pictures and actual color photographs. There are 667 illustrations of which 106 are in color.

The first volume concerns the cystoscope its history and use in diagnostic procedures of the bladder and ureters. In its seventeen chapters can be found reference to nearly everything that is known in modern urology. The section on cystoscopic photography is proof of the author's creative genius in perfecting a camera that will take color pictures intravesically. The actual color photographs of the bladder mucosa both normal and diseased, are accurate and life-like. Nothing like them can be found in any similar publication. This contribution to the specialty is the result of many years of patient labor and is definitely worth the effort.

The second volume is divided into fifteen chapters, eleven of them are devoted to the kidney. Renal anomalies, function tests, injuries, infections, calculi, cysts and tumors are treated in an interesting and able manner. Chapter XXII discusses medical disease of the kidney, a subject not usually covered in a urological text. The last three chapters deal with urology in women and children and urological roentgenography. At the end of each volume is an excellent bibliography covering the subjects discussed in the respective chapters.

The author has been faithful in his intention to present a concise yet complete compendium of every disease observed or diagnosed by the cystoscope. He has presented his material in such a manner as to

make one feel that urology is an important field of medical endeavor. The accuracy of modern methods of diagnosis and treatment is clearly emphasized. We feel that Dr. McCrea has made an important contribution to modern urological literature.

EDMUND CROWLEY

THE interesting monograph entitled *History of Surgical Anesthesia* by Thomas E. Keys has an introductory essay by Chauncey D. Leake and a concluding chapter on the future of anesthesia by Noel A. Gillespie. The excellent introductory comment of Chauncey Leake reviews his personal contacts with anesthesia. He stresses the lack of fundamental knowledge regarding the basic concepts of pain, and marvels at the accomplishments in the relief of pain regardless of the gaps in our knowledge still unbridged.

Thomas E. Keys was reference librarian for the Mayo Clinic and, as a major with the medical corps was assigned to the Cleveland branch of the Army Medical Library. These unusual contacts together with the author's keen historical perception have made possible this exciting human story of the development of surgical anesthesia.

The work includes a revision of the five essays which were published in *Anesthesiology* revision of chronology and a selected list of references arranged by author and subject.

The author has made it his responsibility to correct many of the errors which have crept into the history of anesthesia and to try to present with an unbiased judgment, based on historiography the main contributions. The work will provide for the medical student an interesting picture of the drama of progress in anesthesia during the past 100 years. It will provide the anesthetist with a résumé and bibliography and the discerning anesthesiologist with an up-to-date compilation of many historical facts of anesthesia and related subjects. It can be highly recommended as a concise volume of factual information regarding the history of surgical anesthesia.

MARY KARP

THE second edition of *Nitrous Oxide-Oxygen Anesthesia* by Clement is enlarged by the addition of 30 pages and 22 engravings.

The more important additions or changes in the second edition concern the nitrous-oxide theory of anesthesia, the technique of administration of nitrous-oxide-oxygen, the practical and applied physiology of anesthesia, the mechanism and treatment of shock, the dangers of prolonged oxygen deficiency and details as to the use of the nasopharyngeal airway in dental practice. The discussion of shock as it concerns the anesthetist has been markedly improved in this new edition. The section on physiology has been enlarged and improved through

THE HISTORY OF SURGICAL ANESTHESIA. By Thomas E. Keys. New York: Schuman's, 1945.
NITROUS OXIDE-OXYGEN ANESTHESIA; McCrea—Clement. NEW THEORY AND TECHNIQUE. By F. W. Clement, M.D. and M. C. (A.U.S.) ed. Philadelphia: Lea & Febiger, 1945.

CLINICAL CYSTOSCOPY: A TREATISE ON CYSTOSCOPIC TECHNIQUE, DIAGNOSIS, PROCEDURE, AND TREATMENT. By Lowman E. McCrea, M.D. F.A.C.S. Philadelphia: F. A. Davis Co. 1945.

inclusion of recent advances in research. Considerable space has been devoted to a discussion of airways and particularly the endotracheal technique in anesthesia. As in the first edition there is an excellent review of the signs and symptoms which develop under nitrous-oxide anesthesia and a helpful chapter devoted to the significance of cyanosis.

Full consideration has been given to preoperative medication and this subject is now set apart in a special section. Basic instructions for the administration of nitrous oxide-oxygen are not markedly changed from those of the first edition.

The author emphasizes by repetition the need for preoperative medication for supervision of anesthesia by a well trained and experienced anesthetist for active co-operation of surgeon with anesthetist and for an alert anesthetist who can recognize promptly the symptoms of impending shock and institute proper therapy.

MARY KARP

IT is always delightful, after an absence of months, to greet old and admired friends and when they appear in a jaunty new outfit and still sparkling with enthusiasm and helpful ideas our admiration is redoubled. The new sixth edition of Homans' *Text book of Surgery* brings also an unwelcome reminder of the inexorable passage of time: the distinguished author is now Clinical Professor of Surgery Emeritus, nine of the twenty two original contributors have passed into the Great Beyond—all in the fifteen short years since the appearance of the first edition.

It is hardly necessary to point out again what a felicity of style and expression, what delightful glimpses of historical background and what a rich sense of humor Homans has added to a comprehensive grasp of surgical principles and technique to make this volume an outstanding contribution to the literature of surgery. He has made the task of the surgical student a pleasant one and has broadened his outlook in every direction.

A TEXTBOOK OF SURGERY. By John Homans, M.D. 6th ed. Springfield, Ill. Charles C. Thomas, 1947.

"That remarkable old genius Hippocrates" "not until Vesalius weakened mechanically at the superwork of the *Almagest*" (p. 6) are typical Homansisms phrases that bring sparkle and zest to lure the reader on and make the beginner realize how fascinating the subject of surgery can be.

It is always difficult in reading a new edition of so comprehensive a treatise to gauge accurately the changes and revisions that have been made. As Homans says in his preface "the value of chemotherapy has been affirmed—the advantage of complete immobilization of wounded limbs has been supported—and transfusion of whole blood has been found superior to the use of even the best of the blood substitutes. These statements indicate a few of the lines along which changes and additions have been made. Fortunately sufficient time has passed since the introduction of the sulfonamides and penicillin to give the author an opportunity to make considered statements concerning their indications and use (the sulfonamides) tend to sterilize the blood stream—but they do not kill the bacteria in the initial lesion which still requires surgical drainage" (p. 73).

the local use of such agents in abdominal wounds will probably be entirely abandoned (Allen) Intravenous administration of the sulfonamides results in a rapid high concentration of these drugs in the peritoneal fluids. Foreign body reactions occur in the abdominal cavity after local use of the less soluble members of the group" (p. 958). Penicillin is referred to frequently particularly in connection with spreading infection of cellular tissue, septic sore throat, osteomyelitis, infections of the brain and meninges, of the ear and eye, of the pleural cavity and of the genitourinary tract.

Blood vessel suture blast, the immersion syndrome, the treatment of burns, the surgery of the sympathetic and parasympathetic system (usually comprehensive) external fixation of fractured bones, the technique of skin grafting—are only a few of many subjects which have been enlarged upon or included for the first time.

The bibliographical index—a distinctive feature of Homans' Textbook—again directs the reader quickly and accurately to sources where he may find more detailed discussion and information of specific subjects. All in all the interested reader cannot fail to realize how well the whole field of surgery has been covered and what a distinctive contribution Homans has made to surgical literature.

SAMUEL L. KOOS

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OUTLINE OF PROGRAM FOR CLINICAL CONGRESS AP- PROVED BY BOARD OF REGENTS OF AMERICAN COLLEGE OF SURGEONS

A T a meeting in Hot Springs, Virginia, on April 1 the Board of Regents of the American College of Surgeons approved a preliminary program for the Clinical Congress, to be held at the Waldorf Astoria in New York City from September 9 to 13 in accordance with the following outline

Monday September 9

- 10:00 General Assembly for Surgeons and Hospital Representatives, Grand Ballroom
- 1:30-3:00 Panel Discussion, Empire Room
- 3:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals.
- 3:00 Hospital Conference, Sert Room.
- 3:00 Surgical Film Exhibition (General) Grand Ballroom.
- 3:00-5:30 Assembly of Initiates and reception, Grand Ballroom.
- 3:00-5:00 Panel Discussion, Empire Room
- 8:00 Presidential Meeting and Convocation, Grand Ballroom

Tuesday September 10

- 9:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals.
- 10:00 Hospital Conference, Sert Room
- 9:30 Surgical Film Exhibition (E.E.N.T.) Jensen Suite
- 9:30 to 12:00 Forum on Fundamental Surgical Problems, Grand Ballroom
- 10:00 Surgical Film Exhibition (General) Empire Room.
- 11:00 Group Clinical Conferences
Ophthalmology
Otorhinolaryngology
- 1:30 to 3:00 Panel Discussion, Grand Ballroom
- 3:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals.
- 3:00 Hospital Conference, Sert Room.
- 3:00 Symposium on Fractures and Other Traumas.
- 3:00 Surgical Film Exhibition (General) Empire Room
- 3:30 to 5:00 Panel Discussion, Grand Ballroom.
- 7:00 Surgical Film Exhibition (E.E.N.T.) Empire Room
- 7:00 Hospital Conference—Trustees, Sert Room.

- 8:00 Scientific Session, General Surgery Grand Ballroom.
- 8:00 Scientific Session, Panel Discussion, Ophthalmology Jensen Suite.
- 8:00 Scientific Session, Otorhinolaryngology Le Perroquet Suite.

Wednesday September 11

- 9:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals.
- 9:30 Hospital Conference, Sert Room.
- 9:30 Surgical Film Exhibition (E.E.N.T.) Empire room.
- 9:30 to 12:00 Forum on Fundamental Surgical Problems, Grand Ballroom
- 10:00 Surgical Film Exhibition (General)
- 11:00 Group Clinical Conferences
Ophthalmology
Otorhinolaryngology
- 12:00 Meeting of Governors of College, Jensen Suite.
- 1:30 to 3:00 Panel Discussion, Grand Ballroom.
- 3:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals.
- 3:00 Symposium on Cancer Empire Room.
- 3:00 Surgical Film Exhibition (General)
- 3:30 Hospital Conference, Sert Room.
- 3:30 to 5:00 Panel Discussion, Grand Ballroom
- 7:00 Surgical Film Exhibition (E.E.N.T.) Empire Room.
- 7:30 Hospital Conference, Sert Room.
- 8:00 Scientific Session, General Surgery Grand Ballroom
- 8:00 Scientific Session, Joint E.E.N.T. Empire Room.

Thursday September 12

- 9:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals.
- 9:30 Hospital Conference, Sert Room.
- 9:30 Surgical Film Exhibition (E.E.N.T.) Empire Room
- 9:30 to 12:00 Forum on Fundamental Surgical Problems, Grand Ballroom.
- 10:00 Surgical Film Exhibition (General) Empire Room
- 11:00 Group Clinical Conferences
Ophthalmology
Otorhinolaryngology
- 1:30 Adjourned Meeting, Governors, Grand Ballroom.
- 2:45 Annual Meeting, Fellows, Grand Ballroom.

- 2:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals.
 3:00 Hospital Conference, Sert Room
 3:00 Panel Discussion—Graduate Training in Surgery Jensen Suite.
 3:30 to 5:00 Panel Discussion, Grand Ballroom.
 5:30 Surgical Film Exhibition (General), Empire Room.
 3:30 National and Regional Fracture Committees, Le Perrequet Suite.
 7:00 Surgical Film Exhibition (E.E.N.T.), Empire Room
 8:00 Scientific Session, General Surgery Grand Ballroom.
 8:00 Scientific Session, Ophthalmology Empire Room.
 8:00 Scientific Otorhinolaryngology Sert Room.

Friday September 13

- 9:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals.
 9:30 Surgical Film Exhibition (E.E.N.T.) Empire Room.
 9:30 to 1:00 Forum on Fundamental Surgical Problems, Grand Ballroom.
 10:00 Surgical Film Exhibition (General) Empire Room.
 11:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals.
 Group Clinical Conferences, Obstetrics and Gynecology Sert Room.
 1:00 to 4:00 Plastic Surgery 4 U.Blu. Room
 Neurological Surgery Assembly Room M N
 Thoracic Surgery Jensen Suite.
 Urology Le Perrequet Suite.
 Fractures and Other Traumas, Grand Ballroom.

Orthopedic Surgery Carpenter Foyer and Dining Room.

2:00 Surgical Film Exhibition (General), Empire Room.

This outline, as stated previously is preliminary only, and certain important changes are under consideration which, if adopted, will be announced in the next issue. Next month it will also be possible to publish a much more detailed program.

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The Committee on Arrangements for the Clinical Congress consists of the following surgeons from the New York area.

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INTERNATIONAL ABSTRACT OF SURGERY

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BURNS

Collective Review

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IN comparison to the great economic importance of burns in all parts of the world in times of peace as shown for instance, by the more than 5,000 deaths per year in the United States alone, scientific studies concerned with them have always been relatively small in number and relatively poorly supported. The present war with its lavish use of gasoline and oil as motive power and the use of bombing as a weapon has stimulated the Allies to mobilize national resources and many scientists for comprehensive studies of the consequences of fire. This report will be concerned for the most part with the developments in Great Britain, the British Dominions, and the United States. Nothing is known to the authors concerning any studies on burns in Germany and Japan or in their satellite or conquered countries during the 5 years since Belgium has been cut off from the Allied World.

DEFINITIONS

A. Depth of burn.

For many years the universal custom in the United States and Canada and the preponderant custom in Great Britain has been to classify burns according to their depth into three categories as follows: first degree, simple erythema; second degree, partial destruction of the skin; but without

destruction of all the deep epithelial cells; and third degree, destruction of the full thickness of the skin. In the French literature prior to the war the Dupuytren classification was used by most authors. In this classification the definition of first degree burns is the same. Dupuytren's second and third degree burns correspond to superficial and deeper second degree burns as just classified and Dupuytren's fourth, fifth, and sixth degree burns correspond to the third degree just defined. Converse and Robb-Smith have recently classified the depth of burns in a manner extremely useful to any one who is evaluating the results of treatment. This classification divides the burns in such a way that the deep second degree burns and mixed second and third degree burns, both of which types heal slowly under any treatment, are no longer tabulated with the more superficial second degree burns which heal easily with almost any form of treatment. They use a name rather than a number to describe a burn. Their names, descriptions, and prognoses are compared in Table I with commonly accepted meanings of the degrees of the Dupuytren and American classifications. This excellent classification has been suggested so recently that it has not been used by other authors as yet. However there has been a widespread use by American authors of the subdivision of the "second degree burn" into superficial and deep second degree burns. Admittedly the newly proposed class of mixed burns will contain only a small proportion of the cases in any series, but these burns are a distinct and important entity. The authors of the present review will use this new classification in order to avoid any confusion that may possibly arise by the use of either older classification.

From the Burn Assesment of the Surgical Services and the Thorndike Memorial Laboratory and the Second and Fourth Medical Services (Harvard) of the Boston City Hospital and the Departments of Surgery and Medicine of the Harvard Medical School. The work described in this paper was done under a contract, recommended by the Committee on Medical Research and Training, between the Office of Scientific Research and Development and Harvard University.

This review comprises the major part of a review prepared for the Belgian-American Foundation of New York and the Fourn de la Fondation Française de Bruxelles for distribution in French translation to all the doctors of Belgium. This is one of a series of reviews named Actualités Médico-Chirurgicales.

TABLE I—CLASSIFICATION OF DEPTH BURNS

Degeyres	American	Converse and Rehn-Smith		
Degree	Degree	Name of Burn	Description	Prognosis
1st	1st	Epidermal	Erythema followed by desquamation	Heal well
2nd	2nd	Dermal	Blistering and superficial destruction of the dermis	Heal well
3rd	3rd	Deep dermal	Destruction to deep layers of dermis	Heal slowly
Mixed 1st & 2d	Mixed 2nd & 3rd	Mixed burns	Small areas of deep dermal alternate with small areas of deep burns	Heal slowly
4th, 5th & 6th	4th	Deep	Destruction of whole thickness of the skin into or beyond the fat	Heal with difficulty. Prognosis uncertain unless grafted

At the occurrence of the burn and for several weeks thereafter it is frequently not possible to estimate correctly the depth of the injury. Many small blebs, some broken and some intact, with an external oozing of plasma, visible pink corium, and minimal subcutaneous edema indicate a dermal burn. A dry dead white brown or charred appearance with beginning subcutaneous edema indicates a deep burn. The appearance of other burns is intermediate between those described and these burns cannot be classified until epithelization or granulation have become evident. Dingwall and Patey and Scarff have attempted to solve this difficult problem. The former has observed his cases with ultraviolet light and a filter after intravenous sodium fluorescein injections, and the latter have studied serial microscopic sections of burns and also the naked eye appearance after the application of Van Gieson's stain. Both these methods are promising but neither has been evaluated, as yet by other workers.

Until Dingwall's or Patey and Scarff's suggestions have been found to be widely applicable burns should not be classified until healing or epithelization is well under way. Most of the recent authors have been cognizant of this, but there are a few recent articles which indicate that the authors think they can estimate the depth of a burn when the burn is first seen. This is shown, for instance, by a statement that a given form of treatment has "prevented the burn becoming a deep burn."

B Area of burn

Although the proportionate area of skin burned has long been recognized as useful as a guide to the prognosis of burns, it has now become of even greater importance as a guide to treatment. One of the first needs of a patient with a serious burn is adequate plasma therapy. After a close estimate of the area of the burn and of its proportion to the total area of skin has been made, a formula may be used to estimate the approximate amount of

plasma needed during the first day of treatment. Such a formula will be presented later.

Long prior to its use for this purpose, Weidenfeld and Berkow (16) made studies directed toward simplifying the recording of and comparison of burns. Both studied by actual measurement the surface areas of the parts and of the whole surface of many individuals of all ages. As a result of this work, Berkow's table¹ is constantly in use in this country and Great Britain for the study of burns, and all recent important studies have used it. Both Weidenfeld and Berkow pointed out that the proportionate area of the parts of an individual vary widely between birth and adult life. Peck and Davis, Seeger and Wallace also pointed out this fact, but the majority of important publications that have stressed the use of Berkow's table have mentioned only his table for adults.

While in search of a suitable diagram and standards for the recording of burns in children, Lund and Browder found that Berkow's tables for adults and children, which have been perfectly satisfactory for work up to date, are oversimplified and contain certain errors that should, if possible, be avoided in the more exact studies that are now being made in many clinics. The results of their study are seen in Figures 1 and 2, which are reproduced from their article. It should be noticed particularly that the area of the face makes up a relatively large proportion of the total skin area of infants when compared to the findings in adults, and is counterbalanced by the small area of the infant's thighs and legs. Also, the proportion of skin of all other parts is essentially unchanged from one age to another. The area determined for the trunk is much smaller than the area assigned to it by Berkow.

PATHOLOGY

A Local.

Burns either injure or kill cells. The cell membranes become abnormally permeable to

various substances. A very superficial burn will result in the injury of the most superficial cells but no cells will be killed. A deeper burn will result in the death of cells to a certain depth, and underlying these cells there will be injured but viable cells.

The response to the mildest burn or the response to a more severe burn at the point in depth where the burn is minimal is dilatation of the capillaries and the finer arterioles and venules with markedly increased blood flow through all of the three following, a brief period of vasoconstriction.

In some mild first degree burns this is the only demonstrable result. In slightly more severe burns the capillary walls are injured and leak blood plasma into the tissues. At the same time other cell membranes leak and there is an abnormal exchange of cell constituents into the tissue spaces and of tissue fluid into the injured dead cells. If the burn is deep enough red cells in the capillaries may be damaged or even ruptured immediately.

Because of the leakage of plasma from the capillaries, the tissue spaces become distended with fluid. This fluid if near the surface, forms blisters under the epidermis at first and after rupture of the blisters continues to pour out for more or less lengthy periods of time. The fluid that represents capillary leakage at deeper levels finds its way slowly into the lymphatic system (83). A result of this is greatly increased lymph flow from the area. Both the lymph and the blister fluid coming from the burned area have long been known to be similar in composition to the plasma prior to the onset of infection (134).

Pressman and his associates have recently studied this problem and have found constant amounts of albumin and variable amounts of globulin in blister fluid. Glenn Peterson and Drinker and Cope and Moore (45) have studied the flow pressure and composition of lymph after burns. The amounts of fluid that may be lost through into or under a burn are frequently large, as will be indicated later. It is also extremely important to remember that while the burned skin is permeable to plasma it is also permeable in the other direction. Absorption of various substances will be considered in detail later.

At once, after a burn repair processes start. When the damage is minimal the repair consists of the return of normal tone to the blood vessels of the cessation of leakage, and the absorption of any fluid that is present in the tissue spaces. If

cells have been killed the dead cells are removed by lysis and phagocytosis. In case the burn is deep this process takes place only at the border between the living and the dead cells and the dead cells are sloughed off in masses or sheets. The intercellular collagen resists digestion more than the cells and the collagen fibers keep the slough attached until they are finally digested at the point of demarcation between the living and the dead parts of the fibers. After the slough has separated repair of the denuded surface takes place by a new growth of epithelial cells from islands of living cells, from the edges of the wound or by successful skin grafts. If the derma is destroyed and healing occurs by ingrowth from the edge, the repair may be quite imperfect because a very thin sheet of epithelium covers the dense connective tissue that results from the final contraction of the granulation tissue. Besides being very thin this scar epithelium is poorly nourished and poorly attached to its base. The repair process may be delayed as a result of local treatment, of infection or of various deficiencies, such as those of iron protein or vitamins, but cannot be stimulated to heal except by creating optimal conditions so that there is no interference with cell division and cell maturation.

B Pathology of red blood cells

Inevitably when sufficient heat penetrates to a depth in the tissue where there are capillaries, some red blood cells are injured. In vitro studies have shown that thermal injury of these cells occurs between 52 degrees and 65 degrees C. (167) Lysis frees the hemoglobin which is in the cells.

The occurrence of hemoglobinemia and hemoglobinuria after severe burns has long been known as an indication of a very serious burn. In general, the former is seen only in deep burns of 10 per cent or more of the body area and the latter in such burns of 30 per cent area or more. Hemoglobinemia when it occurs, is found to be most severe immediately after the burn and to decrease gradually during the first 24 to 72 hours. A long duration of hemoglobinemia in the plasma does not occur following burns. Hemoglobin does not appear in recognizable quantity in the urine unless it is present in large amounts in the plasma. Its duration in the urine depends on its duration in the plasma. The hemoglobin in the plasma and the urine has been shown to be for the most part oxyhemoglobin mixed with traces of methemoglobin (167). There is no evidence that burns ever release any form of myohemoglobin such as is found after crush injuries."

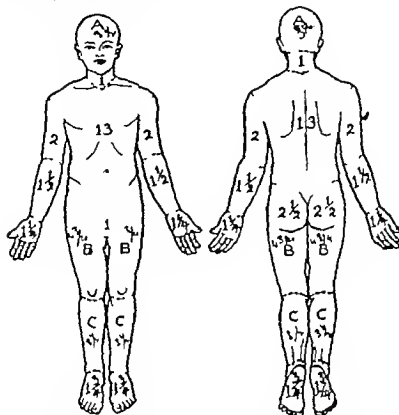
BOSTON CITY HOSPITAL

Name

Age

Number

Burn Record Age 7½ to Adult Date of Observation



RELATIVE PERCENTAGES OF AREAS AFFECTED BY GROWTH

Area	Age 10	15	Adult
A = 1/2 of Head	2%	4%	8%
B = 1/2 of Neck	4%	4%	4%
C = 1/2 of One Leg	8%	8%	8%

% BURN BY AREAS

Probably Not Burn	Head Chest	Neck Shoulders	Body Thighs	1/2 Arm Legs	Arms Feet	Hands
Total Burn	Head Chest	Neck Shoulders	Body Thighs	1/2 Arm Legs	Arms Feet	Hands
Sum of All Items	Probably Not				and Burn	

Sum of All Areas

Probably Not

Total Burn

Fig

Over for Young Children

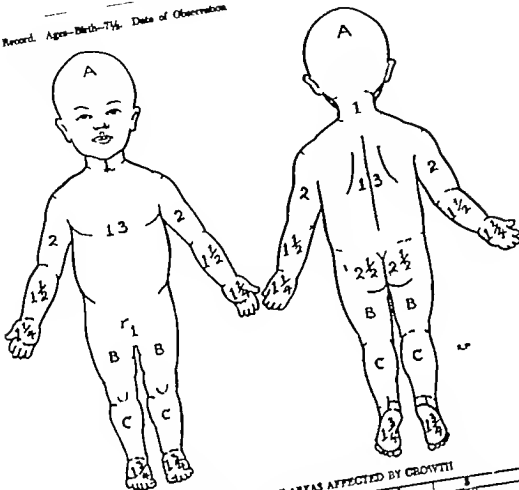
Shen, Ham, and Fleming have confirmed the work of Spiegler and others who found that the blood of the burned patient with hemoglobinemia contained many abnormal red cells, such as fragmented cells and spherocytes with an increased osmotic fragility. No hemolysis or agglutinins are found (28). Hemoglobinemia and hemoglobinuria are discussed with the kidney

C Blood platelets

In very severe burns thrombocytopenia of severe degree occurs. MacDonald and her associates have shown that the platelet count decrease to less than 50,000 within 16 hours of injury and the level may remain low for 60 days. This confirms older work of Salviolelli to confirm that of Welti and Locke

LUND GREEN TAYLOR LEVENSON BURNS

Name _____ Age _____
 Born Record _____ Ages-Birth-Ty Date of Observation _____
 Number _____



RELATIVE PERCENTAGES OF AREAS AFFECTED BY GROWTH

Area	Age 0	1	2	3
	0%	0%	2%	8%
	2%	2%	2%	4%
	2%	2%	2%	2%

A = 1/4 of Head
 B = 1/4 of One Thigh
 C = 1/4 of One Leg

% BURN BY AREAS

Possible 1st Burn: Head _____ Neck _____ Body _____ Up Arm _____ Forearm _____ Hand _____
 Chest _____ Back _____ Thigh _____ Leg _____ Foot _____
 Total Burn: Head _____ Neck _____ Body _____ Up Arm _____ Forearm _____ Hand _____
 Chest _____ Back _____ Thigh _____ Leg _____ Foot _____
 Sum of All Areas _____ Total Burn _____
 Probably 2nd _____ Total Burn _____
 Over for Older Patients

Fig 2

D. White blood cells

Leucocytosis appearing immediately after the injury and continuing for variable lengths of time has long been known as a constant finding in nearly every burn of moderate or severe extent. The early leucocytosis is usually directly proportional to the severity of the burn. Later the leucocytosis varies directly with other evidences

of infection such as fever. In a few cases of severe burns a leucopenia or relative leucopenia has been observed between the first and the sixth days. During the early leucocytosis or leucopenia the differential white blood count may show an increased proportion of nonfilamented leucocytes and other degenerative changes in the leucocytes, and the presence of myelocytes and the absence of

eosinophils. Van Duyn has recently expressed the opinion that these degenerative changes are the result of a toxic injury to these cells and that this proves that there is toxemia associated with burns that cannot be accounted for by injury, hemocoagulation or infection. In his opinion this toxemia is caused by some substance absorbed from the burned area.

E. Renal function

Impairment of renal function as evidenced by anuria, oliguria, and azotemia is a conspicuous feature in the early course of patients with severe burns. Albumin, hemoglobin and casts are frequently found in the urine of these patients, while large numbers of white or red blood cells are rare. Reversible azotemia is associated with transient oliguria occurs frequently even in burns of only moderate severity. This phenomenon is similar to that found following shock of any type and is presumably due to a decreased blood flow through the kidney during shock. The blood flow through the kidney may be decreased to one-twentieth of the normal at a time when the general blood flow is reduced only to one-half (11). This is true particularly in burn shock in which the vasoconstriction at any given peripheral blood pressure seems to be significantly greater than in other types of shock. Van Slyke has shown that a severe reduction in renal blood flow for many hours without reduction in the flow to the rest of the body may be followed by anuria and death of animals.

It has also been suggested that the kidney failure of burns is caused by the hemoglobin that is excreted in some cases (19). This is suggested by the histological changes in the kidney which are similar to the changes in patients with hemoglobinuria due to causes other than burns. The principal histological changes are the presence of pigmented (hemoglobin) casts, nonpigmented epithelial casts and necrosis of the tubules. At autopsy on patients who survived more than 60 hours following regeneration of the tubular epithelium is also seen (26).

Although it is well established that intra-vascular hemolysis from a variety of causes is frequently followed by failure of kidney function the mechanism of this action and the causative agent or agents in the hemolyzed blood remain to be determined. It has been suggested that neither oxyhemoglobin or free hemoglobin is the toxic agent (19) but rather methemoglobin (20) or possibly the same hemoglobin may be the causative agent. It is possible that a third cause

is involved that is that these agents may be more toxic to or only toxic to a kidney with an impaired flow of blood.

The problem of the toxicity of hemolyzed blood is intimately linked with the question whether alkalinization of the urine prevents renal damage. The first urine of patients with severe burns is almost invariably strongly acid and immediate administration of alkali to the patient has been recommended. The purpose of this alkalinization is to prevent precipitation of the products of the destroyed red cells in the renal tubules in the presence of an acid urine (10). In most patients with hemoglobinemia and hemoglobinuria, when first observed have already been present for at least an hour before this examination is made or before any alkalinization is possible. Consequently there are no actual data available as to the prophylactic value of this treatment in human beings and no experiments with animals are known. Although no evidence for or against the value of alkalinization on entry for this purpose has been found after careful studies at the Boston City Hospital and the point is still controversial, we feel that it should still be used. Alkali treatment of burns for other purposes is not new but has recently been brought into great prominence by Rosenthal and by Fox. It will be discussed further under shock.

F. Pathology of the liver

From the time of Bardeen's work there have been reports of liver necrosis in burns. Bardeen described a diffuse injury to all the liver cells. Following Wilson and his coworkers' report in 1938 there began to be many reports of a different type of injury characterized by focal necrosis of the central cells of the lobules. A very marked polymorphonuclear leukocytic infiltration of the necrotic areas. Wilson queried at that time whether the then popular tannic acid treatment had some causal relationship to this change. In 1941 Wells, Humphrey, and Coll, by clinical and experimental work, definitely showed that this peculiar necrosis was due to tannic acid poisoning. This has been confirmed by others (23). It has also been shown that the immediate application of the tannic acid hastens the amount of its absorption and therefore the degree of liver injury (23). The forms of treatment that induce slow tanning such as tannic acid baths or tannic acid jellys are therefore much more dangerous than rapid tanning with 5% acid and 10% silver nitrate solutions (17 & 193). However, as Lee points out there is no liver necrosis encountered in burns treated with

acid is used but very few cases have been reported in which bland ointments, saline solution or dry dressings have been used (63 133 176) A case of marked central necrosis of the liver has been seen when triple dye was used for the surface treatment (115)

Late liver damage as evidenced by jaundice and decreased prothrombin concentration from 2 to 6 months after injury has been seen in a number of patients who have received human plasma or whole blood (114) All of these patients recovered. Clinically these cases are similar to and probably identical with cases of homologous serum jaundice which are due to the transmission of a virus of infectious hepatitis in serum plasma or blood (172)

G Pathology of the kidney

Scattered pathological studies of the kidney in patients dying of burns have been made (131 184 194) the most recent being a report by Goodpastor *et al.*, who found a close correlation between clinical and laboratory evidence of kidney dysfunction, extent of deep burn severity shock, hemoglobinuria, and renal morphologic changes at postmortem. The most consistent anatomical changes were the following on microscopic examination the glomeruli were normal and the tubules showed varying degrees of necrosis affecting principally the ascending and descending portions of the loops of Henle. Pigmented casts in the tubules were a constant finding in these cases. These casts have been considered to be derived from the breakdown of red cells, although direct proof of this is lacking. Some support to this conception is lent by the demonstration of hemoglobin, oxyhemoglobin, and methemoglobin in the blood and urine of all severely burned patients. In addition casts composed of degenerated tubular epithelial cells have been found in most of the same cases. Evidence of regeneration of tubular epithelium was seen in most of the patients in this class who survived more than 72 hours.

In contrast with the marked microscopic abnormalities, the findings of gross examinations were essentially normal. In a few cases the kidneys were swollen the cortices pale, and the medullae dark red, presenting prominent black, brown or purple red streaks corresponding to the papillae. These streaks corresponded to the tubules filled with pigment casts.

It is quite apparent from the description that the renal changes are similar to those following hemolytic blood transfusion reactions, traumatic shock crush injury and hemolytic sulfonamide

reactions. Goodpastor *et al* believe that the important etiologic factors of injury to the kidney in burns are the presence of marked hemoglobinemia hemoglobinuria and severe shock.

H Pathology of the gastrointestinal tract

The occurrence of ulceration of the intestinal tract following burns has been recognized for over 100 years. Curling directed special attention to this subject in 1842. Harkins (87) has recently reviewed the reported cases. The occurrence of gastrointestinal ulceration following burns is more common than coincidence would allow. A severe third degree burn often of a sloughing septic type is most apt to result in such a complication. A decreased incidence of this complication may come from a more aseptic handling of burns. The only other therapeutic considerations are the realization of the possibility of these ulcers and institution of the proper medical or surgical treatment of them as is indicated. Up to the present time, no acute ulcer following burns has been treated surgically.

Children and females are more often affected but this may be because they are more frequently burned. The symptoms of such an ulcer may be of rapid onset and include epigastric pain of melena and hematemesis. The average length of life in ninety four cases with necropsy collected from the literature was 15.4 days.

The ulcer involved the duodenum alone in seventy-one cases, the stomach in five cases. The ulcer cases, and both organs in multiple thirty cases, and single fifty seven times and multiple thirty four times. Hemorrhage was twice as apt to be a fatal factor as perforation and the pancreas was often exposed and the pancreaticoduodenal artery eroded. Thirteen reports of gastrointestinal ulceration with recovery are also mentioned by Harkins.

The etiology of the ulcers has not been determined. Various theories involving nervous, infectious, toxic, and embolic factors have been suggested (87). Necheles and Olsen studied the gastrointestinal secretions following burns, as the salivary, pancreatic, and biliary outputs were considerably diminished. The gastric secretions however were increased by several hundred percent with an associated increase in gastric motility. These writers believe that these observations bring forth "new light on the problem of Curling's ulcer."

Actual ulceration of the gastrointestinal tract has been seen only once in the Boston City Hospital series of 60 recent autopsies. Therefore, Levenson *et al* (115) think that it is a rare complication.

tion under the present modes of treatment. However the same observers as well as Mallory and Brickley have confirmed the older observations of congestion of and diffuse hemorrhage from the upper gastrointestinal tract in human beings. They made these findings only in those patients with extensive burns and severe shock. In Leverson's series there were 6 instances of these findings but as mentioned above only 1 Curling's ulcer. Similar changes have been found more frequently in experimental animal, particularly the dog and cat (75). These changes were accentuated by preburn and postburn hyperinization of the animals (75).

I. Respiratory tract

Up to 1912 injury of the respiratory tract had occasionally been reported as a complication of burns. At that time injury of the respiratory tract assumed great prominence since the majority of the victims of a fire at a Boston night club (The Coconut Grove) in which about 500 people lost their lives, had suffered damage to their respiratory tracts. The clinical and x-ray aspects of these cases will be discussed later. Pathological examination (130) revealed that the respiratory damage was essentially that of a laryngotracheobronchitis. Three patients who were dead on arrival at the hospital were examined at autopsy and all showed an intense but nonnecrotizing hemorrhagic tracheitis and bronchitis, and presented heavy voluminous lungs from the cut surfaces of which fluid in large amounts could be expressed. Microscopic examination confirmed the presence of acute pulmonary edema and demonstrated in the upper tracheobronchial tree a serohemorrhagic exudation without significant leukocytic infiltration (110).

In individuals who died after varying periods of time in the hospital, (1 to 12 days) severe necrotizing tracheobronchitis was found with the formation of a pseudomembranous membrane. Many of the respiratory passages were occluded by the pseudomembrane and visceral muoid and sanguineous exudate. Pulmonary damage consisted chiefly of congestion, edema and scattered areas of atelectasis, emphysema, hemorrhage and pulmonary infarcts. Pneumonia developed in the upper lobes and was usually infrequently associated with scattered necrotizing lesions.

The etiology of the lesions has not been clearly shown. It is assumed that the respiratory tract was primarily an indirect part of the burn and that particularly when resulted from the burning of the face and neck. The victims were

inhaled enough to render them unconscious sustained the severest respiratory damage (111). Similar pathological findings were reported in the Cleveland Clinic fire of 1928 (141). However special fires involving many people are necessary to cause this type of lesion. Gumpert *et al.* found 19 cases at autopsy on 10 patients dying of sporadic burns and Leverson *et al.* (113) observed many patients who recovered in their series of 600 sporadic burns. The only factor in common to all of the patients was that they had inhaled much smoke. A few cases resulted from the inhalation of smoke from a fire involving only a bed.

J. Adrenals

Weiskotten stated in 1917 that the most prominent and characteristic necropsy findings in patients with burns were changes in the adrenal glands. He described swelling, necrosis, and periaxial edema with hemorrhage in all cases of more than 24 hours duration. Microscopically there was necrosis of the cortical cells. Since then others (17, 142, 79) have reported similar findings in some but by no means all, burn syndromes. The most recent report is that of Mafora and Brickley who found focal necrosis of the adrenal gland in 2 cases in which death occurred from 2 to 3 days after the burn. They mentioned swelling of the coils of the outer portion of the cortex with accumulation of serous exudate in the space produced, pyknotic nuclei, acidophilic necrotic of the adrenal cells, and infiltration with polymorphonuclear cells.

The finding of depleted cortical hypoadrenalism, largely cholesterol, following burns has been recently confirmed by Sayers *et al.* who state that in burns the adrenal glands are stimulated to exhaustion by the adrenotropic hormone of the anterior pituitary lobe. Markens (90) has stated similar findings and conclusions.

K. Spleen and lymph nodes

Bardeen described swelling and necrosis of the lymphoid nodules of the lymph nodes pericardial lymphoid tissue and spleen which he considered characteristic of burns and indicative of trauma. These observations were made in children who died from 4 to 935 hours after injury. In a recent review of 95 burn autopsies Baker drew attention to the presence of karyorrhexis (fragmentation) of the cells in the lymph nodes. He found that high degrees of karyorrhexis were found only in children dying within 3 days more than minimal karyorrhexis was observed in a single subject beyond 3 days.

Baker raises the questions whether the karyorrhexis is pre-existent to the burn i.e. a normal finding in children and whether its absence later is not the abnormal feature. Further studies are required to clarify this point.

L. Heart.

Kayashima found that after experimental burns in rabbits, electrocardiograms were abnormal. The waves were low in amplitude, the T wave was flattened out, and the ventricular complex tended to be monophasic. Similar changes were observed by the same author in 12 Naval casualties (from 21 to 37 years of age) with from 12 to 20 per cent body surface burns who recovered. Histologically interstitial myocarditis with perivascular infiltration of leucocytes was observed in the rabbits. Buss and Hartman reported 2 cases in human beings (among 6 autopsies) of microscopic fragmentation of the myocardial muscle fibers.

M. Pathology of the central nervous system.

Delirium, stupor, coma, convulsions, hyperpyrexia, and Cheyne-Stokes respiration signs which may indicate central nervous system injury have been described following extensive burns. There have been very meager reports on the pathological changes of the nervous system. Wilson in reporting on a series of extensive scalds and burns mentioned toxic damage in the brain in occasional cases but did not localize the lesions. Pack quoted Cnle as saying that the central nervous system injury was seen only as a result of profound shock. Mallory and Brickley reported cortical ganglion necrosis in 1 of the Coconut Grove cases, but the patient had suffered from severe anoxia in addition to external burn. She had evidence of carbon monoxide poisoning, shock, and severe respiratory injury the first two causing anoxia from the start and the latter causing it later.

Walker and Shenkin have reported on 6 patients who were observed to die of sudden respiratory arrest. All their patients showed essentially the same signs clinically: disorientation and mania or stupor with abrupt failure of respiration but without obstruction of the airway. Five of the patients died about the fourth day but the sixth died on the sixty-second day. Post mortem examination showed cerebral edema with evidence of marked increased intracranial pressure including widening of the gyri, narrowing of the sulci, herniation of the temporal uncus through the incisura of the tentorium and herniation of the cerebellar tonsils into the foramen

magnum. There were marked changes in the smaller blood vessels consisting of degenerative changes of the endothelial lining with occasional breaks and perivascular petechial extravasations. The ganglion cells throughout the brain showed toxic degeneration, but the most striking changes were in the cortex and hypothalamus particularly in the latter.

According to these authors the pathogenesis of these lesions is not clear. Anoxia or the presence of a circulating toxin (32) as suggested by Christophle must be considered. He showed by cross circulation experiments that changes occurred in the paratubular centers especially at the paraventricular and supraoptic regions of the anterior thalamus. It should be borne in mind however, that Walker and Shenkin's patients showed generalized edema as well as cerebral edema, and it is possible that the cerebral changes are a secondary effect. Many additional studies are needed to clarify these points. Unfortunately the few autopsies that have been done on burned patients have seldom included an examination of the head.

METABOLIC CHANGES IN BURNS

A. Electrolyte metabolism

The findings of a decrease in plasma chloride concentration in the first few days following an extensive burn first reported by Davidson in 1926 has since been confirmed by a number of workers (32, 180, 163, 179, 70, 44, 177). These later studies have also demonstrated a decrease in serum sodium concentration and a decrease in urinary sodium and chloride excretions. Fox and Keaton Cope (44) and Hirsfield (95), using radioactive sodium have confirmed Underhill's and Lowdon's findings that much of the lost sodium chloride went into the burned area.

A shift of some sodium into the injured cells in the burned area with a shift from the injured cells of an equivalent amount of potassium has been demonstrated by Fox and Keaton and Tabor and his associates (170). The actual rise in circulating plasma potassium concentration is small and well below the toxic range for normal animals (196). However, Tabor (171) has shown that the shocked animal is considerably more sensitive to rises in plasma potassium concentration than the normal animal.

B. Nitrogen metabolism

Cuthbertson first noticed in 1930 that patients with fractures excreted abnormally large amounts of nitrogen in the urine for weeks after the injury and that this was associated with a loss of weight

and muscle wasting. Lucklo noted a similar process in a burned patient. His observations were amplified on large numbers of patients in a group at the Boston City Hospital (114) during the last 3 years. It was found that all severe burns that were neither anuric nor too severely oliguric had a high output of nitrogen in the urine during the first 3 weeks and that in a few cases this output continued for many months. Steady losses of from 25 to 30 grams of nitrogen per day have been observed frequently, and on an occasional day the loss may be as high as 45 grams. This early increase in urinary nitrogen excretion has also been reported following any acute trauma, poisoning or infection (25, 50, 99, 124). The cause of the excessive nitrogen excretion has not been finally determined. There may be more than one precipitating factor. Associated with the high urine excretion is an early high nonprotein nitrogen level in the blood which is the result not only of a decrease in kidney function (transient or permanent) but also of an increased production of nonprotein nitrogen products (76). Clearing of the increased nonprotein nitrogen is counted for only a small fraction of the total urinary nitrogen in urine. In severely burned patients there is destruction of large amounts of tissue followed by autolysis and absorption of its products. There is also the possibility that the protein catabolism is increased by the absorption of specific substances from the burned areas (139) and from the so-called "toxic degeneration of protein" associated with fever and infection (140). Increased glucocorticosteroids may be responsible for part of the increased protein breakdown. Browne postulates an increased production of S hormone by the adrenal cortex and simultaneously a decreased production of A hormone which results in an increased protein breakdown as a step in the formation of glucose. In any event it has been recently shown that marked abnormalities of the carbohydrate metabolism do occur in severely burned animals (141) and human beings (176) and are associated with hyperglycemia, lactic acidemia and a lowered carbon dioxide combining power. This will be considered in more detail later.

Harker et al. (91) found a rise in plasma amino nitrogen, a slight rise in plasma ammonia nitrogen and a variable nitrogen but no change in liver ammonia nitrogen or amide nitrogen. Taylor et al. (101) showed that plasma amino acids in human beings and found rises only in patients with severe burns who were in shock. Taylor et al. (101) also found that the plasma amino acids in the urine of these patients were in shock. Taylor et al. (101) also found that the plasma amino acids in the urine of these patients were in shock.

early increased nitrogen, both in the blood and urine is due in some cases to the presence of normal amounts of "residual nitrogen," in addition to an increase of normal substances such as urea, creatine, creatinine and amino acids, which are found in the normal blood and urine. Satisfactory chemical characterization of the compounds has not been made.

At the same time that from 25 to 30 grams of nitrogen are being excreted in the urine an additional 30 to 40 grams of nitrogen may be lost in the surface of the burn daily (173, 95, 47). So important losses of nitrogen from the surface are commonly seen only in extensive deep burns. In these the losses may continue over long periods of time. Early after superficial burns there is a large outpouring of plasma-like fluid through the skin. This contains a high proportion of protein. Later during the sloughing and granulating stages of deeper burns there is a steady and considerable loss of protein in the form of purulent material from the surface. The amount of loss varies directly with the area involved. These losses continue until healing is complete. Such losses from surfaces and wounds have not in the past been considered in calculating conventional nitrogen balances, and it must be realized that errors of great magnitude may be introduced in such studies unless this factor is considered.

While the large quantities of nitrogen are lost in the urine and in the drainage from the wounds of such patients, the protein intake is likely to be greatly reduced by reason of pain, anorexia and poor gastrointestinal function. The negative nitrogen balance occurring under these conditions may have serious effects in a few days in the patient with already depleted body protein and in a few weeks in a patient with excellent protein nutrition. This is reflected in the development of a progressive hypoproteinemia. This is an extremely serious metabolic sign. During the first week following a burn a transitory hypoproteinemia may be present. It is due to shift of water, electrolyte and protein from the blood stream into the subcutaneous tissue and edema. This early hypoproteinemia is without nutritional significance. On the other hand, a continuing fall in plasma proteins after the first week is a good marked tissue protein deprivation. Laboratory studies are taken early, weight loss, edema, loss of strength, and death from malnutrition ensue. Methods to combat this process will be discussed.

C. Carbohydrate metabolism.

Hyperglycemia, lactic acidemia and a lowered carbon dioxide combining power are frequent accompaniments of severe burns.

in human beings and animals following burns (54, 180, 127). The extent and duration of the changes in these blood constituents are roughly proportional to the severity of the burn. Clark and Rossiter working with rats and Greenwald and Eliasberg (79) working with rabbits found decreases in the muscle glycogen following burns. Similar determinations have not been made in human beings. Any increase in lactic acid production due to an increase in the rate of muscle glycogenolysis may result in hyperglycemia through conversion of the lactic acid to glycogen and glucose in the liver. The rate of lactic acid formation following burns is, however, apparently greater than the liver can handle, resulting in lactic acidemia as well as hyperglycemia. In addition to an increased glycogenolysis, another possible source of the extra blood sugar is glucose derived from protein (24).

Many investigators have emphasized the role of the adrenal glands in the production of abnormalities in the carbohydrate metabolism in burns. Hartman (94) has demonstrated an early increased adrenalin production. Browne and Cope *et al.* (47) found increased 17 ketosteroid excretion in the first few days following burns, which was followed by a decrease below normal values. Numerous pathological studies, as already mentioned, have revealed adrenocortical hypertrophy and marked depletion of lipoids. Adrenalectomy was found by Slocum and Lightbody to prevent the lactic acidemia but not the hyperglycemia in burned rabbits, while Clark and Rossiter found that neither the lactic acidemia nor the hyperglycemia was abolished. It appears that although the adrenal glands may play an important role in the production of abnormalities in carbohydrate metabolism following burns, the entire picture cannot be explained on this basis and indeed the effect of the adrenal glands may be of a secondary nature.

D. Vitamins

Increased demands for vitamins in burns have been suspected for some time by analogy with studies showing increased needs for vitamins in other diseases (81). Empirically vitamin preparations such as cod liver oil have been used locally (121) and orally for many years in the treatment of burns. Very few assays of vitamins in the blood, urine, or tissues to determine the actual requirements in burns have been made.

In 1937 Usbekov studied the content of ascorbic acid in the adrenal glands and in the liver of guinea pigs that were kept on various diets before and after burning. He found a progressive

fall in the ascorbic acid level in these organs following burns of from 45 to 50 square centimeters of skin. This decrease occurred in all animals no matter whether their diets were high or low in ascorbic acid. The pigs on partially deficient diets showed indolent healing and 'poor' granulation tissue and lost much weight. The animals on better diets lost less weight and had 'better' granulation.

Lam reported low plasma ascorbic acid concentrations in a few patients with extensive burns. Clark and Rossiter and Harkins (90) reported a decrease in adrenocortical ascorbic acid concentration following burns in rabbits, rats, and guinea pigs. Lund, Taylor, Johnson, and associates have studied plasma ascorbic acid concentrations and urinary excretions of ascorbic acid, thiamin, riboflavin, and *N*-methyl nicotinamide in man in the acute and chronic stages of burns. They have found that in patients with severe burns on high protein diets supplemented with two or three times the National Research Council daily allowances of these vitamins recommended for healthy individuals (38) the plasma level of ascorbic acid and the urinary excretions of all four vitamins may decrease to very small quantities. Even with small burns the patient on a nonsupplemented house diet may do the same thing. In patients with consistently low plasma and urine ascorbic acid levels the granulation tissue is absent or edematous, skin grafts fail and epithelialization is delayed. Burned patients with low excretions of B vitamins may have poor appetites, poor bowel function, asthenia and poor morale. The extra needs for vitamins commence with the burn and remain until healing is complete. In general the extra amounts needed to prevent depletion parallel the area of unhealed burn. Whether it is desirable to try to maintain fully saturated levels of ascorbic acid in the blood and the excretion of appreciable quantities of all four vitamins in the urine is not known. The maintenance of such levels will, in very severe cases, entail the administration of up to 2.0 grams of ascorbic acid, 50 milligrams of thiamin, 50 milligrams of riboflavin, and 500 milligrams of niacinamide. Comparable studies on any of the fat soluble vitamins and on all other water soluble vitamins have not been made.¹

BURN SHOCK

Burn shock may be defined as a condition of low blood plasma volume, low cardiac output, low blood pressure and increased peripheral re-

¹Since this was written Andrews and associates have reported studies of the balance of riboflavin in burns and have found an increased need for it during convalescence.

LUND GREEN TAYLOR LEVENSON BURNS

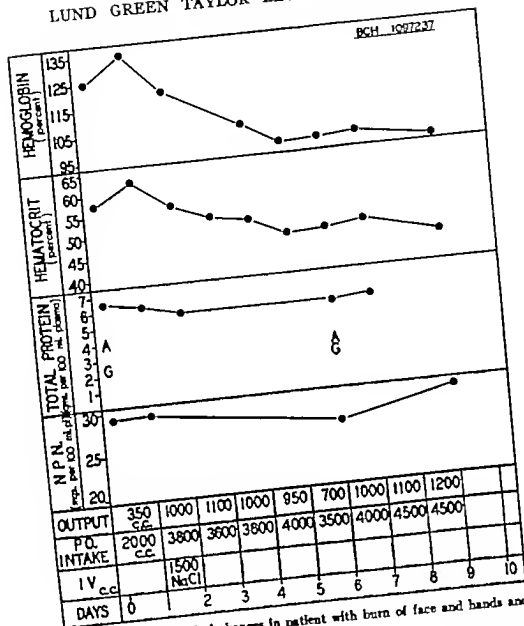


Chart 1 Hematological changes in patient with burn of face and hands and without shock.

degrees C. for from 2 to 3 minutes died in shock without visible edema and exhibited insufficient local fluid loss to account for death. Similar results were obtained when larger areas of the body were severely burned for 10 seconds. These authors concluded, It is therefore apparent that there are at least two mechanisms capable of producing shock one due to local fluid loss and the other due to some unknown factor.

Another important contribution to our knowledge concerning toxins has been made by Perlman, Glenn and Kaufman who described a large amount of a new globulin fraction in the lymph collected directly from the burned area in calves. This globulin may represent a toxin.

Rawlinson and Kellaway have found great increases in phosphatase phosphate proteolytic

enzymes esterase, and catalase from heated liver slices as the temperature approached 50 degrees C. Kellaway and Rawlinson studied tissue in jury by heat in isolated limb preparations. From the perfused hind limbs of guinea pigs and the forelimbs of cats histamine was liberated between 45 degrees and 50 degrees C. In the early hours of perfusion a substance relaxing smooth muscle which inhibited the stimulating effect of histamine was present in the perfusate. No active adeny compounds could be detected between 37.5 degrees and 50 degrees C. but cardio-depressant activity was found between 42 degrees and 50 degrees C. This was also present in the subcutaneous edema. It was heat stable and was not diminished by incubation with cat muscle or cat liver extracts. The hydrogen ion concentra-

tion of the perfusate showed its greatest increase between 44 degrees and 45 degrees C. The small output of inorganic phosphates between 37.5 degrees to 41 degrees C. was markedly increased at the higher temperatures. Alkaline phosphatase, lipase, and proteolytic enzymes were also set free above 41 degrees C. These authors concluded

"The demonstration that lipase and proteolytic enzymes were set free from the perfused hind limb of the cat above 41 degrees C. gives color to the possibility that toxic products may be formed by enzymatic activity in the tissue spaces. Proteolytic enzymes in lymph from the burned area have also been reported by Zamecnik *et al*

Rose and Browne have found very high blood histamine levels immediately after the burn. The amount of histamine present decreases rapidly as toxemia develops. These findings are not altered by the administration of sufficient plasma to prevent hemoconcentration. There is a correlation between the degree of injury and the decrease of the histamine content of the blood. Thus, the most marked decrease has been noted from 12 to 36 hours before death. Similar findings have been observed in cases of fatal shock.

Beloff and Peters have found a proteinase that is liberated from burned skin that they discuss in relation to "burn toxin theories," but they do not claim that it causes burn shock.

Muys and Hardenbergh have observed that the oxygen consumption of normal rat liver slices is increased when measured in lymph from the burned legs of calves or one dog as medium. The increase over similar measurements in normal lymph was as great as 41 per cent. When serum was collected after burning a smaller increase was found. In this connection Taylor and his associates (196) have found an increase in the basal metabolic rate in severely burned patients. The rise was greater than could be accounted for by the fever that was present at the time of the test.

Aub (7) has found that the fluid obtained from within the sheath of a muscle that has been made ischemic by the interruption of its circulation produces shock when injected into normal dogs. Exotoxins produced by organisms of the bacillus welchii group were found in this fluid. These bacilli were found to be normal inhabitants of normal dog muscle. Under the anaerobic conditions of these experiments the number of organisms and the amount of toxins produced are greatly increased. The toxic effect of this fluid is nullified if suitable antitoxin is mixed with the fluid, or injected separately but simultaneously into the dog. Animals immunized with toxoids are resistant.

Chalkoff and his associates have found that fluid expressed from the skin and subcutaneous tissue of burned areas in dogs is toxic to rats. Gram positive anaerobic bacilli and other organisms have been identified in this fluid. After Zeitz filtration the fluid is still toxic in most instances. Aub has found that these anaerobic organisms are not normally present in the tissues of man. At present there is no evidence that these toxins are important in the pathogenesis of burn shock in man.

This discussion of burn toxins in relation to burn shock is far from complete and mentions only a few of the important studies that have been made. There seems to be no doubt that many chemicals are released from the area of a burn that all together play a part in the depression of the circulatory system after a burn.

3. Pain. At the moment of burning and for a few minutes after burns cause sharp pain. Then there follows during the next few hours and, even occasionally for several days, a period of almost complete freedom from pain. At later stages burns may be among the most painful of all diseases. Until recently pain has been considered to be a very important cause of shock following burns. Many experiments have been carried out to evaluate the importance of pain as a factor in various other forms of shock, but in burn shock the only experiments of this kind are those of Kabat and Hedin. Unfortunately their experiments on dogs are inconclusive for several reasons, particularly because their burns did not produce shock but merely produced a moderate rise in the hematocrit. Recently the experimental evidence from studies of afferent stimuli as a factor in the production of traumatic shock has indicated a much smaller influence from such stimuli than the many older studies, such as those of Crile, indicated. From an excellent recent study of traumatic shock in dogs Phemister and Laestler conclude, in part, as follows "No evidence was obtained from these limb trauma experiments that a flow of nociceptive stimuli from the injured field is an important contributing factor in the initiation of any circulatory impairment or shock which followed."

Evidence derived from the treatment of patients with burns in shock shows that, even in the exceptional instances with severe pain, sedatives have essentially no therapeutic effect on shock comparable to the effects obtained with suitable intravenous fluids such as will be described.

4. Cold and heat. Under war conditions and in connection with civilian airplane accidents some patients with burns suffer from exposure to

cold or heat for long periods of time before and after an accident. In peace time civilian life such complications are only seen in disasters of the living magnitude or in the case of individuals living under isolated conditions. Either excessive cold or excessive heat will contribute to the severity of shock, but quantitative studies of the role played by cold and heat have not been made. Some very important observations on the treatment of burn shock in a chilled or heated environment will be considered in the section on the treatment of shock.

B The diagnosis of burn shock

Many writers have described the clinical picture of burn shock. As with other forms of shock it is very simple to make the diagnosis in its final stages. One merely has to determine that the pulse and blood pressure are unobtainable. However the earlier periods of impending or mild shock are more difficult to diagnose. Since shock once it is well established is much more difficult to treat than when it is in its earlier stages, it is important to foresee impending shock so that prophylactic measures can be taken.

Careful estimation of the area and of the approximate depth of a burn is important for the anticipation of shock. As already mentioned any patient with a burn area of 25 per cent or greater will probably suffer from shock and any patient with a burn area of 25 per cent will probably suffer from fatal shock unless prompt and active treatment is given.

The pulse and blood pressure should be taken at one-half hour intervals during the first 24 hours. However they are not good indicators of impending shock, since because of the increased peripheral resistance the pulse may remain slow and the blood pressure normal when the blood volume has already been reduced to a critically low level. Suddenly the blood pressure will fall to a dangerous level and even then the pulse may not rise.

Direct blood volume determinations are the best indications of reduced blood volume but they are not practical for clinical work. Hematological determinations are practical and serve as essential guides. Hematocrit, hemoglobin and red blood cell determinations are useful. Except for research purposes serial determinations at 2 to 3 hour intervals of any one of these is sufficient. The blood examined must be venous rather than capillary blood because of stagnation in the capillaries.

As indicated in Table II apparently normal hematological findings may be seen in the pres-

TABLE II—CALCULATED CHANGES IN BLOOD AND PLASMA VOLUMES ACCORDING TO CHANGES OF THE RED BLOOD COUNT PER CENT OF HEMOGLOBIN AND PER CENT OF PACKED RED BLOOD CELLS IN PATIENTS WITH VARYING DEGREES OF ANEMIA BEFORE INJURY

	Observed				Calculated	
	Hemo- globin Per cent	Red Cells Millions Per cent	Red Cell Volume Per cent	Plasma Per cent	Volume Per cent Low	Plasma Volume Per cent Low
Orig. inal	100	5	35	65	100	100
110	110	5.5	38.5	61.5	90	90
120	120	6	42	58	80	80
130	130	6.5	45.5	54.5	70	70
140	140	7	49	51	60	60
150	150	7.5	52.5	47.5	50	50
160	160	8	56	44	40	40
170	170	8.5	59.5	40.5	30	30
180	180	9	63	37	20	20
190	190	9.5	66.5	33.5	10	10
200	200	10	70	30	0	0

ence of severe loss of plasma in a previously anemic patient. Note in Table II that a slightly elevated hemoglobin of 110 per cent, if found in a patient whose preburn hemoglobin was 70 per cent, indicates that he has already lost 33 per cent of his plasma volume and 37 per cent of his blood volume—a loss that would probably cause severe shock.

Serial plasma protein determinations also provide useful information. As plasma is lost from the vascular bed there is a shift of low protein extravascular (chiefly interstitial) fluid into the blood stream. This results in dilution of the plasma protein. If the shift is rapid there is a greater fall in the plasma protein concentration than in the hemoglobin concentration. In some instances the hemoglobin may remain normal and a falling plasma protein may be the chief laboratory indication of impending shock.

Accurate records of urine output must be kept. Lauson *et al.* have shown that renal blood flow and urine output may be markedly reduced at a time when the peripheral pulse and blood pressure are normal. If the urine output is good one may feel sure that the general circulation is good; if however the output falls one must anticipate early failure of the general circulation.

C Secondary effects of burn shock

The effects of severe burns without shock and of severe shock without burns are similar in many instances. For instance, increases in the blood sugar, lactic acid, nonprotein nitrogen, amino acids, ammonia, and hydrogen ion concentration and decreases in sodium chloride and ascorbic acid are common to both. When shock occurs in burns it results in an intensification of the same changes that had already commenced before the shock had started. Quantitatively the severity of these metabolic changes parallels the severity and duration of the shock. One metabolic change, however has been recently observed in shock of various types, including burn shock, that is never seen in burns, no matter how severe, if shock is prevented by efficient treatment. Tagnon and his associates (174) have demonstrated the occurrence of fibrinolysis in both burn and hemorrhagic shock. Fibrinolysis is the spontaneous dissolution *in vitro* of the clots in blood within 24 hours. This phenomenon disappears promptly with recovery from shock.

Another complication of burn (and other forms of) shock is "irreversible shock." As a result of the anoxia and cellular injury that results from prolonged circulatory insufficiency a point is reached where complete restoration of the blood volume will no longer result in the return of a sufficiently adequate circulation to maintain life. If the systolic blood pressure remains below 90 mm. for more than 3 or 4 hours the shock is almost surely irreversible, and frequently it may become so in a shorter period of time. Studies have not been made on "irreversible burn shock," but studies (66) on "irreversible hemorrhagic shock" have indicated that failure of liver function is one of the earliest and most important changes that lead to "irreversibility." There has been discussion in the past of the role of generalized capillary leakage as a factor in the initiation of "irreversible shock." Some observers have claimed that it was important, and others that it did not occur. Fine and Selligman (67) have demonstrated why both sets of observers may have been correct in their observations under the limitations of their particular experiments. They have shown that there is no capillary leakage at a distance from the burn or other trauma, or at any place, when hemorrhagic shock is studied, from the commencement of shock or during the whole time that the blood pressure is very low. However if the shock period has been long enough, generalized capillary leakage starts as soon as the blood pressure is brought up by restoration of the blood volume. This leakage under these condi-

tions may be one of the major factors in determining "irreversibility." Because of the great danger of "irreversibility" it is imperative to prevent shock when possible and to treat it promptly and vigorously when it occurs.

D The prevention and treatment of burn shock.

The first principle of treatment of any form of shock is to avoid, in so far as possible, any treatment of the patient that will increase the shock, and to postpone necessary shocking procedures (such as dressings) until shock has been prevented or treated. The positive measures for the treatment of shock are taken up first. Of these measures, those that restore and maintain the blood volume are of paramount importance and are discussed first. Omission of them can in no way be compensated for by any of the adjuvant methods of treatment discussed later.

1. Human plasma and serum. In burns, as indicated previously, the fluid that is lost from the vascular bed is similar in composition to blood plasma. Consequently it is logical to replace the lost fluid with plasma, and it has been demonstrated that burn shock may be prevented or successfully treated in nearly all cases if seen early by plasma transfusions in adequate amounts.

The amount and rate of plasma administration depends on many factors. First, it should be borne in mind that the amount of fluid lost is roughly proportional to the area of surface burn. However burns of certain areas, such as the face and genitalia, which are highly vascular and have loose subcutaneous tissue are accompanied by particularly high fluid losses. Second, the rate of fluid loss is maximal in the first few hours after a burn and then gradually decreases so that at the end of from 36 to 48 hours an equilibrium is reached between the amount of fluid lost and the amount returned to the blood stream from the interstitial spaces. Third, both clinical and laboratory data must be considered in determining the amount of plasma to be given.

Progressive hemoconcentration, falling plasma protein concentration, falling blood pressure, and a rising pulse are indications of impending shock. There are many formulas suggested for estimating the plasma dosage based on blood concentration (50, 58). The most commonly used is that of Harkins (89). (a) give 100 cubic centimeters of plasma for every point that the hematocrit exceeds the normal of 45 per cent, or (b) give 50 cubic centimeters of plasma for every point that the hemoglobin exceeds the normal of 100 per cent.

As pointed out previously, such calculations, based on an assumed normal hematocrit may be

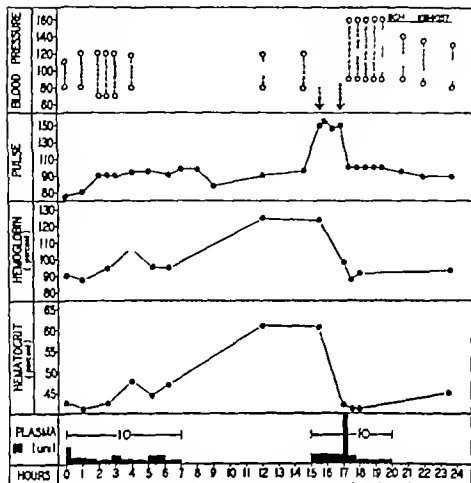


Chart 2. Effect of plasma on burn shock. Blood pressure was not obtainable. (The vertical arrows mean that the blood pressure is not obtainable.)

erroneous if the patient is anemic prior to injury. Serial hematocrits should suggest this possibility and calculations should be based on an approximate preburn hematocrit. In addition, such calculations do not indicate the amount of plasma that will be needed to manage the entire course of the burn shock. Consequently frequent hematological observations must be made during the first 24 to 48 hours. This is well illustrated in Chart 2.

The patient whose course is outlined in Chart 2 was a man of 50 with flame burns of 55 per cent of his body surface, chiefly deep. His blood pressure, pulse, hematocrit, and hemoglobin were normal on entry. Ten units (2,500 c. c.) of plasma were given in the first 7 hours during which time his burns were treated with tannic acid and silver nitrate. His hemoglobin pulse and blood pressure remained normal, and plasma infusion was stopped. Five hours later his hematocrit and hemoglobin were markedly elevated but his pulse and blood pressure were still normal. During the next 2 hours the patient became chilly, nauseated and complained of feeling sick. Sud-

denly he became cold, pale and clammy. His pulse was very rapid and thready and his blood pressure was unobtainable. The administration of 1,000 cubic centimeters of plasma during the next 90 minutes restored the hematocrit to normal, but had no effect on the pulse and blood pressure. In the next 10 minutes 800 cubic centimeters of plasma were given into the femoral vein by the multiple syringe technique with a return of the pulse and blood pressure to normal.

This illustrates the necessity of administering plasma rapidly when shock is present. Advantage of rapid infusion in shock is also implied in the recent publication of Kohlstaedt and Page who advised intra-arterial rather than intravenous administration of fluid. However one may construe the efficiency of their intra-arterial administration of plasma to a more rapid administration. Caution must be used of course, in infants, old people, and those with heart disease. In the normal adult with a large burn as much as 2,000 cubic centimeters may be given in a period of an hour without danger of overloading the circulation.

The dosage of plasma on the basis of the extent and location of the burn is also of value, particularly where laboratory facilities are not available. About 100 cubic centimeters of plasma for each per cent of body surface burned should be administered to patients with 10 per cent or more area burn. All of this plasma should not be given at once but should be given according to the following schedule which approximates the rate of fluid loss: one-half should be given in the first 4 to 6 hours, one-quarter in the next 6 hours, and the last quarter in the next 12 hours. Smaller amounts may be required in the next 24 hours in rare instances.

Attention should be paid to the clinical appearance of the patient. One of the best guides of adequate therapy of shock is a good urinary output. If a clinical impression of additional plasma need is at variance with the laboratory findings, the latter should be disregarded. The first 6 hours following a severe burn are critical ones so far as plasma administration is concerned. It is during these first few hours that the physician has the greatest opportunity to prevent shock. No unnecessary delays should be tolerated. When the usual peripheral veins are not available, there should be no hesitation about employing the femoral route or in cutting down on a vein. The use of the femoral route was a lifesaving measure in the treatment of many patients at the Boston City Hospital where at least a thousand of such punctures have been made for withdrawing blood or injecting various solutions intravenously.

Another factor influencing the amount of plasma required is debridement. It is common experience that large amounts of fluid are lost from the body during such procedures as debridement and the cleansing of large burns. The burned skin, although badly damaged and partially permeable to plasma, nevertheless acts as an important dam to the extravasation of fluid because of the coagulation of exudates and partial drying of them on the surface. The removal of this barrier and consequent opening of tissue spaces is accompanied by an increased fluid loss.

This may be seen by examination of Chart 3. The patient whose course is described in Chart 3 was a 32 year old woman with flame burns of 65 per cent of her body surface, chiefly deep who was treated initially with 7 units (1750 c.c.) of plasma given over a period of 1½ hours. At this time she went into shock despite the absence of significant hemoconcentration. It was known that her hemoglobin prior to injury was about 85 per cent. After a further period of 2 hours, during which time she continued to be in shock,

infusion of plasma was recommenced and the patient responded with a rise of blood pressure to normal. While the infusion was still being administered, debridement was begun. During the course of the operative procedure both the hematocrit and hemoglobin rose abruptly which indicated a considerable increase in the rate of fluid loss. Wilson *et al.* who used cleansing and debridement routinely prior to tanning, commented on such fluid loss and pointed out the high incidence of shock following this procedure.

Serum may be used in place of plasma with equally good results, as has been demonstrated by its use in large series of cases in Canada and Great Britain. The reactions which were reported in the early days of serum have not been seen in the later series of cases. Most of the early reactions may have been due to the fact that fresh serum contains thrombin and other substances which are toxic. After a few hours, and certainly after the 2 weeks during which the serum is now held before use, such substances have disappeared.

Human albumin. As a result of the work of Cohn and his associates, the United States Navy and the American Red Cross have produced large amounts of human albumin for the treatment of shock. Very little has been available for civilian use to date. A few reports indicate that it has value in the treatment of burn shock (10). At present it is shipped in highly concentrated form (35%) and can, if indicated, be administered without dilution. For emergency treatment of the patient who is not dehydrated it may well prove to have some definite advantages over plasma. It has the advantage that it has a much greater osmotic effect on the circulation than the same amount of protein in the form of plasma. However it has the disadvantage of being a "pure solution" that is, it does not contain substances such as prothrombin which are also lost or depleted in shock (174). Zamcnik (198) has shown that in dogs with hemorrhagic shock which are treated with albumin there is a marked fall in the prothrombin concentration, whereas no such fall occurs if whole blood or plasma are used. Janeway and associates have reported a marked fall in the plasma globulin in a burn patient who received large quantities of albumin intravenously. Additional saline solution and water must be given to patients receiving albumin to replace the interstitial fluid which is drawn into the vascular system by the osmotic action of the albumin.

3. Electrolyte. Saline solution has long been used in the treatment of shock. There is evidence that if it is given intravenously at rapid or moderate rates of injection the blood pressure of the

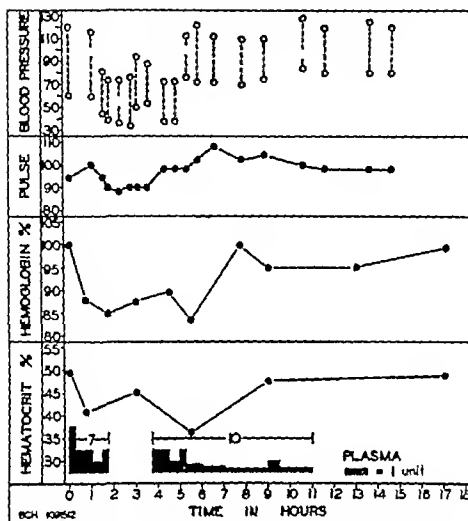


Chart 3. Effect of débridement on rate of fluid loss in a patient with an extensive burn.

shocked individual may be raised but the effect is frequently transient. In addition it appears that plasma protein may be "washed out" by the saline solution (21). For these reasons saline solution was replaced by plasma or serum in most clinics when these solutions became available, as they did quite generally in the United States, Great Britain, and Canada between 1940 and 1942. Interest in the use of saline solution alone or in conjunction with other sodium salts has recently again been aroused by the reports of Rosenthal and of Fox. Rosenthal experimenting on mice with standardized burns, has shown that the effects of sodium salts given intraperitoneally or by mouth very soon after the burn are slightly but significantly superior to the effects of serum given intravenously in preventing death of the animals within 48 hours. In his series the effect of the serum appeared to be due not to the contained protein, but to the sodium. He also showed that the therapeutic effect of the sodium salt was due

to the sodium radical rather than the acid radical since different sodium salts acted in the same manner. Potassium salts increased the mortality. Saline solution when given intravenously was not as effective as when given by mouth. Isotonic saline solution was more effective than the hypertonic solution. Prinzmetal *et al* have also reported good results in mice with sodium therapy. Fox treated a number of severely burned patients by the oral administration of sodium lactate or sodium bicarbonate and saline solution. He gave from 10 to 15 per cent of the body weight of isotonic sodium salts in the first 24 hours. Any vomiting such as occurs frequently in patients with severe burns, was treated by the administration of more oral fluid. The results appeared to be good. It must be stressed that in the studies reported the sodium was used chiefly for prophylaxis and not for treatment of fully developed shock. In addition dangerously low plasma protein levels were seen in some of the patients

This work needs careful consideration. For the moment it would appear that while it is true that there is a deficit of sodium in the burned patient, it is also true that there is a deficit of other substances and, although it undoubtedly is necessary to replace the sodium, it is also necessary to replace the other substances. It appears to us that sodium salts are necessary adjuncts to the treatment of burn shock, not the sole therapeutic agents. The work of Moyer *et al* and Abbott *et al* on the use of sodium chloride and sodium bicarbonate solutions with whole blood which will be described in the section on whole blood, are of interest in this regard.

4. Whole blood. Whole blood was used extensively to treat burn shock until 1940. Then plasma and serum became generally available in large quantities and almost entirely replaced it. Among other reasons it was widely believed that additional red blood cells could serve no useful purpose when the blood was already concentrated. However during the last 3 years, interest in whole blood has revived, principally because of the work of Moyer *et al*. They studied the therapeutic effects of various solutions on the shock of severe, deep burns of dogs. The dogs were shaved and two-thirds of their surface areas were scalded for 30 seconds by water at 85° C. A combination of transfusions of defibrinated blood and gavage of normal saline solution with added sodium bicarbonate solution was the only form of treatment that prevented shock without inducing such complications as cerebral and pulmonary edema in compatible with life. The unsuccessful forms of treatment were (1) intravenous administration of saline and bicarbonate solutions, (2) intravenous administration of saline and bicarbonate solutions and dog's serum, (3) intravenous administration of dog's serum with saline and bicarbonate solution by gavage and (4) intravenous administration of defibrinated blood with water given orally ad libitum. Abbott and his associates have found that whole blood transfusions given during the first day of the burn not only aid in preventing shock in human beings, but also alleviate or prevent the subsequent anemia that frequently appears about the third day after plasma has been used. Levenson *et al* (115) and Evans and Bigger have also treated burn shock successfully with whole blood in a small series of carefully studied patients.

5 Glucose. The early increased blood sugar in severe burns might be considered to contraindicate the administration of glucose intravenously. However Taylor and associates (176) have demonstrated that there is no impairment of

glucose tolerance or loss of excessive amounts of glucose in the urine under these conditions. In addition burns cause depletion of the muscle glycogen and possibly of the liver glycogen so that efforts should be made to restore glycogen to these tissues by an adequate administration of carbohydrate. Finally as mentioned previously there is an early increase in the nitrogen catabolism, and glucose in large amount may alleviate this. Glucose should be given in substantial quantities. Harkins *et al* (91) recommended up to 300 grams in the first 24 hours for severe burns. However glucose must be considered to play only a minor role among the many substances given to these patients, and to be almost or entirely without value if it is given in pure solution for either prevention or treatment of shock.

6 Gelatin. Degraded solutions of gelatin have been studied as plasma substitutes in the therapy of burn shock in dogs (147) and the consensus of opinion is that properly prepared gelatin solutions are as effective in the acute phase from the points of view of osmotic properties and mortality as plasma. Koop (108) has come to the same conclusion in working with human patients. However plasma possesses a number of properties beyond the osmotic characteristics shared by gelatin and since there are other losses from the blood beyond the loss of osmotic properties it would appear that plasma would offer some advantages.

7 Gum acacia solution. Although interest in this solution was shown by several investigators up to 1940 its use has completely stopped with the advent of human plasma and serum. Not only have these substances been found to be better but, also acacia has been found to be harmful when given in repeated doses (8a).

8 Oxygen. The defenses of the body against shock and the efforts to maintain blood volume are all in reality attempts to achieve one goal, the maintenance of normal cellular metabolism which is dependent upon adequate oxygenation of the tissues. As indicated previously tissue anoxia results from the failure of the peripheral circulation. There is no experimental evidence that inhalation of 100 per cent oxygen alleviates the tissue anoxia accompanying shock. Oxygen has been widely used clinically in the treatment of burn shock, but the only clear indication for it is complication of the burn shock by respiratory tract injury.

9 Position. The indications for raising the foot of the bed or placing the patient in the Trendelenburg position are not as clear in the treatment of shock from thermal burns as in the

reatment of simple syncope, since in the burned patient there is no pooling of blood comparable to that in simple syncope. In the burned patient the fluid is lost externally or into the subcutaneous tissue, and it cannot be readily returned to the vascular tree by change in position. However it appears that the circulation to the brain is improved by tilting the bed even though the blood volume may not be materially altered. It is especially important to raise the foot of the bed during the first few minutes after the onset of shock while other more effective methods of treatment are being started.

10. External temperature. Because many patients in shock are cold it has been customary to cover them with many blankets and also to use hot water bottles or other sources of heat. Blalock has shown that overheating is detrimental to the animal in traumatic shock, and Elman and associates (61) have shown that both heating and cooling are harmful to burned animals. As already mentioned, occasional patients have markedly high fevers from 18 to 24 hours after a burn. It is important that for patients in shock with a rectal temperature below 34.0 degrees C. or above 40.0 degrees C. very active measures be taken to warm or cool them promptly but these measures must be stopped as the temperature approaches normal.

11. Sedation in shock. As recently as 1942 it was customary to treat burns with very large doses of opiates. Beecher has shown that this is not a safe procedure when shock is present. He points out that morphine is contraindicated in the treatment of fear or hysteria or of any condition in the presence of anoxia. It should be given only to relieve pain. Most importantly he calls attention to the fact that no drug is readily absorbed from the tissues if administered subcutaneously or intramuscularly to a patient in shock. He presents the history of a patient in burn shock who was given repeated doses of morphine subcutaneously without effect. As soon as her circulation was effectively restored by treatment with plasma the whole amount of the drug was taken rapidly into the blood stream and gave the usual effects of an overdose of morphine. Energetic measures were needed to combat these effects. Therefore when opiates are indicated in patients with shock they must be given intravenously.

Another aspect of this problem has been studied by Elman (61) who showed that the mortality of burned dogs was increased when usual doses of morphine or of barbiturates were given. In view of these findings, morphine and other sedatives

should be used cautiously in patients with incipient or actual burn shock. Anesthetics have the same harmful effects, and are very dangerous in incipient or actual burn shock. Cyclopropane is safest if one is necessary (21) but Levenson and his associates have found no occasion to use anesthesia at the time of the first dressing in their most recent 500 cases seen during the last 2 years.

12. Pressor drugs. Frank and his associates have recently studied the therapeutic effects of various pressor drugs in irreversible hemorrhagic shock in dogs. They found no indication of beneficial results from the use of pitressin with or without ergotamine, paredrine, coramine, or tuamine. Earlier work by Cannon (30) indicated that the capillary blood flow may be actually lowered when such drugs are used. No such studies have been made on burn shock, but by analogy these studies indicate that these drugs would be of no value.

13. Adrenocortical extract. As described in the section on pathology there is evidence of adrenal injury following burns. In addition there is laboratory evidence of increased outputs of adrenalin (159) and of various corticosteroids (24, 47). Rhoads, Wolff and Lee (157) reported promising results from the use of adrenocortical extract in the treatment of burn shock. A more recent report by the same authors reverses this opinion (158). The later clinical observations were corroborated by the experimental studies of Rosenthal, who found that in standardized burns in mice there is no protective action produced by either desoxycorticosterone or adrenocortical extract injected subcutaneously when compared with controls injected with saline solution. Lowdon *et al* had previously reported failure to decrease the mortality of burned animals by the use of desoxycorticosterone. Cope and Moore (45) have demonstrated in dogs that adrenocortical extract has no influence on the abnormal permeability of the capillaries in the burned area. In view of the failures encountered, there is no indication at present for its use in the early post burn period.

14. Vitamins. Govier working on hemorrhagic shock in dogs, has indicated that B complex vitamins, particularly thiamin have a definite therapeutic effect on the shock. In addition to their findings mentioned previously on the effect of burns on vitamins Lund, Johnson Taylor and associates (126) have found great depletion of water soluble vitamins during the shock phase of burns. They believe it is logical to administer large doses of these vitamins early after admission of the patient.

15 Anesthesia and surface treatment. The very serious effects that these items may have on burn shock will be discussed in the subsequent section on surface treatment.

RESPIRATORY COMPLICATIONS

Injury of the respiratory tract is an important complication of a few thermal burns. It should be suspected in any patient who gives a story of having inhaled large amounts of hot smoke, particularly if consciousness has been lost. Patients with injury of the respiratory tract usually have burns of the face, but this condition may be seen in patients with no external burns (68). Singeing of the fibrillae of the nares, soot on the face, and burns of the nasopharynx are commonly seen in these cases. As described in the section on pathology the fundamental lesion is a necrotizing tracheobronchitis. Finland *et al* found the usual symptoms to be cough, hoarseness, dyspnea, and stridor. The sputum was mucoid, purulent, and bloody. Occasionally casts of trachea and bronchi, resulting from pseudomembrane formation were coughed up. The vital capacity was greatly diminished. Physical examination revealed scattered areas of dullness, hyper resonance, and rales of all varieties, but chiefly crepitant or fine wheezes. X rays showed scattered small areas of emphysema, atelectasis, and congestion. Secondary pneumonia, chiefly due to the staphylococcus aureus, was seen in some patients.

Any patient in whom injury of the respiratory tract is suspected must be watched very closely. A tracheotomy kit should be kept at the patient's bedside. Respirations should be charted every half hour. Examination of the nose, nasopharynx, epiglottis, larynx, and vocal cords should be made. If burns of the nasopharynx are present, swabbing the nose with bland oil and having the patient gargle with a warm soothing solution, such as glucose in water will be helpful.

If cough or dyspnea develops, the air should be humidified. If these symptoms progress in spite of humidification, the patient should be placed in an oxygen tent. Inhalations of 10 per cent carbon dioxide and 90 per cent oxygen should be given for a few minutes every one to two hours to induce deep respirations. The patient should be moved frequently and encouraged to cough. If there is any wheezing or other signs of bronchial spasm, aminophyllin or adrenalin should be given intravenously or adrenalin should be given by nebulizer. Generalized laryngobronchial spasm may occur very suddenly and may lead to death of the patient unless it is relieved immediately. Tracheotomy with artificial respiration may be

necessary. Tracheotomy is also indicated if stridor or air hunger or other signs of laryngeal obstruction appear. Suction through the tracheotomy tube should be done repeatedly as needed. When simple aspiration through the tracheotomy fails, bronchoscopic aspiration may succeed.

A dose of 25,000 units of penicillin should be given intramuscularly on entry and repeated every 3 hours. If the urine output is good, sulfadiazine may also be given. If the patient is restless, one must first rule out anoxia, and, if present, steps such as have been described should be taken to provide for oxygenation. For restlessness due to pain, meperidine hydrochloride should be used rather than morphine or any other respiratory depressant. For restlessness due to nervousness or anxiety the barbiturates should be used (74).

If the patient with injury of the respiratory tract has extensive surface burns in addition, plasma should be given without hesitation to prevent or treat shock. Finland found no evidence to indicate that plasma infusions under such circumstances led to pulmonary edema. Plasma may also very rarely be indicated in the patient with respiratory burns who has no external burns.

INFECTION IN BURNS

Infection is always a serious complication of extensive deep burns, and frequently or rarely according to the efficacy of treatment, a complication of lesser burns. Its control is, therefore, one of the most important aims of therapy.

A. Initial contamination. A burn immediately after the accident harbors few pathogenic organisms since the process of burning sterilizes the skin in the affected area. However unless protected, the lesion is rapidly contaminated. Great sources of serious contamination are the respiratory secretions of individuals handling the patient (33). Also important are the materials which come in contact with the burn and the bacteria that may remain viable in the deep crypts and ducts of the skin in the burned area, or in the skin of adjacent areas.

B. Bacteriology. In careful bacteriological studies of burns in patients cared for in a special ward at the Royal Infirmary at Glasgow Clark (33) found that the hemolytic streptococcus was the predominant infecting organism. This corroborated the previous studies of Aldrich in 1933 at the Johns Hopkins and the Boston City Hospitals. However, most of the studies that have been carried on during the last 4 years at many widely separated civilian hospitals in the United States have shown that hemolytic streptococcal infec-

tions in burns are infrequent (135, 117). They show that burns at all stages are almost always contaminated or infected with several organisms. Aerobic, anaerobic, gram positive, and gram negative bacteria, and cocci may all be found in any single culture. The number of varieties of bacteria found is usually related to the care and variety of the culture methods employed. Serial cultures taken from a single burned area show changes from time to time in the variety and proportions of the different organisms. They also show that the hemolytic staphylococcus is the predominant pathogenic organism. Almost every culture at any stage of the many burns studied by Meloney (135), Lyons, and Levenson (117) have shown it to be present. It has not been eliminated by sulfonamide or penicillin as given to date. Fortunately its mere presence does not prevent successful grafting (117). When the hemolytic streptococcus is predominant, however it does interfere with successful grafting in many cases. Fortunately it may be eliminated by the use of large doses of penicillin (113) or of sulfonamides (3). Acute hemolytic streptococcus infection of the burn with the rash of scarlet fever occurs occasionally in children. It responds well to chemotherapy.

Symbiotic infections in which an anaerobic or microaerophilic streptococcus is associated with one or more other organisms occur rarely (135). Under these conditions there may be burrowing of the infection at the edge of the wound and destruction of otherwise viable dermal tissue.

An unexpected finding of Meloney's study was the frequency with which anaerobic organisms were observed. However there was essentially no clinical infection with the bacillus welchii or other clostridia except the bacillus tetani. It must not be forgotten that clinical tetanus is occasionally seen in burns and that tetanus antitoxin should be given prophylactically to all patients with deep burns.

The more frequently encountered bacteria are listed in Table III in approximate order of their importance.

The skin in dermal burns retains most of the resistance that normal skin has against infection. If rest and avoidance of recontamination are provided, any organisms growing on the surface soon die out as healing progresses (42). With deep burns the problem of infection is much more serious because deep burns are always infected from a few hours after the burn until healing is complete. During the first 2 to 6 weeks necrotic slough is present on the surface and it furnishes an excellent medium for bacterial growth. After the slough

TABLE III—VARIETIES OF BACTERIA FOUND COMMONLY IN CULTURES FROM BURNS

<i>Staphylococcus hemolyticus</i> , coagulase positive
<i>Streptococcus hemolyticus</i> , (beta and gamma)
<i>Bacillus proteus</i>
<i>Bacillus pyocyaneus</i>
<i>Bacillus coli</i>
Diphtheroids
Other staphylococci
Other streptococci
Other enterococci
<i>Pneumococcus</i>
<i>Bacillus mucosus capsulatus</i>
<i>Bacillus welchii</i>
<i>Bacillus tetani</i>
Other clostridia

has separated the open granulating wound continues to harbor bacteria as long as the wound is open. The question of control of infection by local and general measures will be considered later.

HYPERPYREXIA IN BURNS

Patients with burns frequently have a period of high fever (over 41 degrees C) in the first few days after the burn. This is observed in adults only if they are burned extensively but in children, and particularly infants, it may occur as a complication of small area burns. The occurrence of delirium, stupor, convulsions, or coma should suggest the possibility of hyperpyrexia. The oral temperature may frequently be misleadingly low, and rectal temperatures should be taken of all such patients. Infants in particular should have hourly rectal temperatures taken during the first 24 hours, and 2 hourly temperatures during the next 24 hours. The pathogenesis of this early high fever is not known. It does not appear to be due to infection since in most instances there are no signs of spreading infection, either at the time of the fever or later. Pyrogens in intravenous fluids are responsible only occasionally. Shock and dehydration may play a role, but in many cases high fever is seen in the absence of these factors. Increased heat production due to the increase in metabolism as a result of extensive burns together with, and more important, the decreased ability of the patient to lose heat because of the greatly restricted area of exposed normal skin may be important. Walker and Shenken believe that in many cases the fever is cerebral in origin.

The burn patient cannot tolerate a high fever so that if the rectal temperature remains above 41 degrees C for more than a very few hours death is almost certain. Prompt and energetic treatment directed toward cooling the patient is effective in many instances and this treatment should be started whenever the rectal temperature is above 40 degrees C. If the fluids given have

been inadequate, more fluid will help but the main attention should be directed to ice water sponge baths to all exposed skin. If less than 50 per cent of the skin is exposed it may be necessary to remove some of the dressings. Windows should be opened, drafts created, bed clothes removed, and an ice water bath made in the patient's bed. He should be sponged for $\frac{1}{2}$ hour or more until the rectal temperature is brought to 39 degrees C but not below this.

PRIMARY LOCAL TREATMENT

A Introduction.

During the decade from 1930 to 1939, tannic acid, tannic acid and silver nitrate, gentian violet, and triple dye¹ displaced to a large extent all former methods of primary surface treatment of burns in the United States and Great Britain and its Dominions. From 1937 to date other forms of treatment have been advocated strongly and have now replaced the tanning methods as completely as the tanning methods replaced the older methods a few years earlier.

All methods of treatment of burns have always been based on an attempt to correct some one or more deleterious effects of the burn. Tannic acid was introduced to reduce the external fluid loss and to fix postulated toxins in the skin. The dyes were introduced to accomplish the same results and to furnish also an antiseptic action. In 1937 Allen and Koch introduced the now well known pressure dressing. They claimed that the pressure reduced both internal and external fluid loss and that infection was reduced by careful initial cleaning and by the rest and protection furnished by the bulky dressing. Originally no antiseptic except boric acid ointment was used.

With the introduction of the sulfonamides into medicine, they were immediately introduced into the treatment of burns. Pickrell used a solution containing sulfanilamide that was sprayed on to form a transparent eschar. Others used various sulfonamide ointments, or merely dusted on the drug and covered it with petrolatum or a bland ointment. Gurd combined the cleaning and pressure method of Allen and Koch with a sulfathiazole "cream." Others used preformed films containing sulfonamides (6). Whether or not sulfonamides were used on the surface they were also given by mouth or parenterally. New anti-bacterial agents, such as propamide, were discovered and used. Finally with the discovery

and production of penicillin, it was used locally and parenterally. In order to secure more complete rest and more even pressure, plaster casts were introduced to replace pressure dressings in some cases. Recently the washing of burns was given up by Cope (43) and washing, ointments of all kinds, and routine chemotherapy were given up by Levenson and Lund (117). Complete excision of small area burns on entry with immediate skin grafting has been carried out successfully. Delayed excision and skin grafting of more extensive burns have been used by Cope and Moore (46). Chemical excision of the burn with early skin graft was successful in serious cases (39).

There is still no general agreement as to primary local treatment. Recently however certain fundamental conceptions have been widely accepted and have led to a more nearly unified view of treatment. The first of these is that the cure of local areas in a patient with burns of any important size is but part of the total treatment of the patient. The second is that the treatment of the patient should be based on methods to correct as far as possible the many physiological and pathological changes brought about by the burn. Local plasma loss should be limited, further contamination prevented, and infection controlled. Any surface application should cause no local or general toxic effects. Application of the treatment should be rapid and relatively easy and the least possible attention should be required thereafter. It should be stressed, however, that no fixed routine can be established for all cases. An understanding of the underlying principles will make it clear when variation in methods should occur.

B Fluid loss

In addition to the harm done by the loss of fluid from the circulation by causing shock, the fluid is harmful to the subcutaneous tissues because it clots there and increases the extracellular pressure with resulting increased fibrous tissue (75). This results in subsequent impairment of function. This is evident particularly in burns of the hands in which it is often seen that following some dermal or deep dermal burns there is marked limitation of motion of the fingers. On review of these cases it is found that swelling occurs early and persists for some time. In contrast, it is found that in cases of similar severity in which minimal swelling has been prevented, function is unimpaired (74, 118). It is apparent, therefore, that from the point of view of both local and systemic reactions, one of the features to be desired of any local treatment is that it limit the amount of internal and external fluid loss.

¹The formula used under this name vary. One is:
Gentian violet
Resorcinol green
Acetic acid
Disinfectant water ad

1 Washing of burns. Washing of the burned area opens up previously closed tissue spaces and leads to a considerable increase in fluid loss, as was pointed out in the discussion of Chart 3. The relation of washing to infection will be discussed later.

2 Escharotics and pressure dressings and casts. Tannic acid and other escharotics until recently have been widely employed for primary treatment, in part because of their ability to prevent external exudation of fluid from the burned area. There is no doubt so far as the tannic acid and silver nitrate combination with its rapidly forming eschar is concerned that this end is accomplished. While the use of tannic acid is not desirable because of its toxic action on the liver nevertheless the necessity of prevention of external losses of fluid in occasional dermal burns may be judged from the following experience.

The patient was a 22 month old child weighing approximately 15 kilograms who was admitted to the hospital with hot water scalds involving 25 per cent of his body surface. The burned areas were oozing plasma at a rapid rate. There was very little subcutaneous edema. The surface was treated by the application of petrolatum and pressure bandages. The external loss of plasma was not arrested and the bandages continued to be soaked with fluid for at least 36 hours. During this time 8 units (2,000 c.c.) of plasma were administered with no hemodilution. This amount of plasma represented approximately three times the plasma volume of the child. In spite of this, shock occurred three times in the first day. Had it been possible to prevent the enormous surface loss this very large amount of plasma would not have been required.

It has been our experience that pressure dressings, or casts, applied over ointment, have very little effect on the amount of fluid lost externally while the agents which rapidly form eschars do stop surface leakage. However treatments aimed at sealing off the burned surface do not and cannot prevent the loss into the subcutaneous tissues. As pointed out by Underhill Harkins (87) and more recently by Glenn and his colleagues (75) this subcutaneous loss in deep dermal and deep burns is considerable and may surpass the external loss. The latter state that in one of their dogs with burns of the two front feet plasma equivalent to more than one-third of the animal's blood volume passed into the area from the tibiae to the humeroradioulnar joints.

An example of the failure of tannic acid to prevent internal fluid loss may be derived from a re-examination of Chart 2. Shortly after admis-

sion the patient was treated with tannic acid and silver nitrate solutions. Fifteen minutes after such treatment the external extravasation of fluid from the burned areas ceased completely and yet the rising hematocrit and hemoglobin showed that fluid loss continued for many hours. As a matter of fact the presence of increasing subcutaneous edema was easily discernible on physical examination. This subcutaneous loss of fluid has been minimized experimentally in dogs (74) and clinically in human beings, by the use of close fitting plaster casts (12, 116) and elastic pressure dressings (5).

C Local tissue injury caused by surface treatment

It is desirable that no further injury be imposed on the burned area by the agent used in the local treatment. It has been shown that the escharotics, as opposed to bland ointments injure viable epithelium. Partial thickness donor sites heal significantly faster under a firm ointment dressing than under tannic acid and silver nitrate or triple dye (29, 97). Healing of dermal burns of the back takes place a few days earlier if ointment is used rather than either tannic acid and silver nitrate or triple dye (36). Epithelialization under a dry gauze pressure (113) or saline pressure (143) dressing proceeds at the same rate as under a petrolatum dressing.

D Systemic effects of substances applied locally to the burned area

Absorption of certain types of substances from the surface of both second and third degree burns has been demonstrated (132). Therefore, it is important that any agent used in the treatment of the burned area either be not absorbed, or if absorbed, be relatively nontoxic. This is especially important when burns of a large area are being treated. Jaundice and other evidences of liver damage are seen more frequently in patients treated with tannic acid than in those treated with bland ointments (93).

Boric acid ointment has been used often in the local treatment of burns. Boric acid has no particular virtues and since it may be absorbed in toxic amounts if applied over a large area of injured skin (150) it had best be avoided and simple petrolatum used.

Sulfonamides in soluble form, if used locally may be absorbed in toxic amounts (120). Therefore if used the preparation should remain in effective concentration locally and yet not be absorbed rapidly enough to cause general systemic reactions. Since there is often early oliguria in severely burned individuals, the possibility of

kidney damage secondary to the sulfonamides is increased. A 5 per cent sulfathiazole emulsion from which the absorption is relatively slow has been used with good results (80)

E. Prevention of infection

Strict aseptic technique in the handling of burned patients is necessary to prevent additional contamination of the wound.

1. Washing and débridement of burns. Until recently the custom of washing and débriding burns had not been challenged. The characteristic view was that expressed in the following quotation "To cover a burned area with chemical or coagulating solutions without first using every effort to transform it into a clean wound seems to us inexcusable disregard of fundamental surgical principles (5). However it should be borne in mind that a burn is different from the ordinary soft tissue wound. Initial contamination is slight and it is rare that subcutaneous tissue and muscle are exposed. The type of débridement practiced in the primary care of soft tissue wounds cannot be carried out in any except very small burns. Even simple washing of a burn has certain disadvantages—the increase in time, fluid loss, handling, and pain—which make it preferable to omit washing if possible. Routine washing of burns has recently been shown not to be necessary if pressure dressings or casts are used (43, 116). However it is generally agreed by those who do wash burns that it should be done gently and quickly. White soap has been most commonly used rather than tincture of green soap.

2. Prevention of further contamination. It is essential that the area be protected from further contamination. When escharotics are applied, the eschar which is at first intact, soon cracks and further contamination is thereby possible. Pressure dressings or casts which remain dry on the outside prevent the entrance of additional organisms. If however the dressing becomes saturated with exudate contamination is possible. This has been minimized by the incorporation of a cellophane membrane in the dressing (143).

At each dressing change there is the possibility of further contamination. Consequently dressings should be done at infrequent intervals. The first dressing should remain in place for about 2 weeks. At the end of this time most dermal burns are healed and require no further dressing but deep dermal, mixed and deep burns are just beginning to slough so that additional dressings are required.

3. Immobilization. The importance of immobilization in the control of infection has been amply

demonstrated. The absorption of toxic products, metabolic or bacterial, depends to a large extent on the lymphatic flow which is reduced considerably by rest of the injured part (12). In contrast to surface eschara, pressure dressings with splints or close fitting casts provide for immobilization of the burned area.

4. Chemotherapeutic agents. These agents have been widely used for the control of infection of burns. The sulfonamides have been used both locally and systemically but their efficacy in controlling the local infection of the burn has not been clearly demonstrated. When one considers that there is usually a mixture of gram positive and gram negative organisms in the burned area, and, in addition, there is present considerable necrotic tissue and exudate it is not surprising that there is no striking control by the sulfonamides. In some instances it has been claimed that while the local infection is not controlled, spreading infection and blood stream invasion are prevented (135).

It must also be remembered that all deep burns will have an open wound harboring organisms until the last grafts have successfully healed and that this may take several months. As it is unlikely that any patient can tolerate effective doses of any sulfonamide for this length of time, it is recommended that no general sulfonamide treatment be given as a prophylactic measure or for any other purpose except for some complication such as pneumonia.

Penicillin has been used locally and systemically in many cases of serious burns (117, 96, 191, 22). When used locally it has the great defect of rapid absorption from the wound. To overcome this objection experiments are being made with special ointment bases such as carbowax¹ (136). With such a base some penicillin activity may be maintained for as long as 24 hours. A more serious defect is the rapid destruction of penicillin by the action of penicillinases released by bacteria, such as the colon bacillus, that are present in the wound and which are not sensitive to its action. When given intramuscularly penicillin has not been shown to reduce in any way the hemolytic staphylococcus infection of a burn. Possibly if such an infection were found in pure culture on a burn it might be effective for this purpose, but such pure cultures are seldom seen. Hirschfeld (96) stated that when penicillin was used before and after skin grafting better results were obtained. Levenson and Lord (117) found that it was possible that the change of

¹Carbowax is the name of a series of polyethylene glycols. They are water soluble but have the consistency of grease.

technique of dressing in the preparation for grafting associated with the use of penicillin was more important than the drug. On the other hand, in the few cases in which the cultures from a granulating wound that is ready for grafting in every other way show repeatedly that the hemolytic streptococcus is the only or predominant organism, general penicillin should be used in the dose of 25,000 units every 2 hours for 48 hours before and after the graft. Under this special condition it has been shown to be very useful.

F Technique of application of a pressure dressing

Under operating room conditions fine meshed gauze, dry or impregnated with petrolatum should be applied directly to the wound. Over this, sufficient sterile gauze, absorbent cotton, cellucotton, or mechanics waste should be placed so that even compression can be secured by means of a firm, wide bandage. If the padding is furnished in large rolls of material from 1 to 2 centimeters thick, 20 centimeters wide, and 4 meters long it facilitates the application. It should be emphasized that to be maximally effective the dressing should be applied as soon as permitted by the general condition of the patient, since the greatest amount of swelling occurs in the first few hours following injury. Also since the swelling is not limited to the burned areas, but occurs also in the immediately adjacent areas, these areas must be incorporated in the dressing. In burns of the extremities the dressing must extend distally to cover completely the hand and foot, even if these areas are not burned, otherwise the venous return will be obstructed, and as the back pressure builds up the arterial blood supply will be impaired. Elevation of the extremity may help to prevent stasis and discomfort. In applying a pressure dressing the tension must be uniform and care must be taken that no more pressure is used than is required. In burns of the chest and abdomen a pressure dressing as such cannot be applied without interfering with the patient's respiration. Therefore, in this location a firm bulky dressing without pressure is used.

G Technique of application of close fitting casts

The application of close fitting plaster-of Paris casts is recommended for burns of the extremities particularly for burns of the hands, but it is not recommended for burns of the trunk, buttocks or head. Under operating room conditions, one layer of sterile fine meshed gauze, dry is applied to the entire area to be covered by plaster. This is covered with four layers of sterile open mesh gauze, fitted carefully without overlapping.

Plaster slabs are then molded over the extremity front and back. A thin layer of rolled plaster completes a nearly skintight, light, well fitting plaster cast. The cast must be close fitting but must be applied without compression at any point. As in the case of a pressure dressing it should extend proximally from 7 to 16 centimeters beyond the limit of the burn. In burns of the extremities it must extend distally to cover completely the hand and foot (including the tips of the fingers and toes) even if these areas are not burned otherwise the circulation will be seriously impaired. Hands should be put up in the position of function with a slight cock up at the wrist and fingers in neutral position. It is all important that directions be followed exactly (12, 116). Levenson and Lund have seen instances in which improperly made casts had to be removed to prevent gangrene.

H The use and technique of petrolatum gauze dressings

Allen and Koch Cope (42) and others advise pressure dressings for burns of the face, head, and neck, as well as for those of the trunk and extremities. After using them on a number of patients Levenson and associates (113) have given them up in treating these particular burns. Two reasons led to this decision. First, such dressings were always uncomfortable when used for serious burns. Second, sufficient pressure could not be used to control the edema of the face or neck. They now use sterile petrolatum gauze strips applied without pressure and without bandage. These strips rub off from time to time and new ones are put on by a nurse. They are rectangular and approximately 8 by 16 centimeters. They are made of fine mesh cotton bandage material impregnated with petrolatum and sterilized. Other areas where pressure dressings are impractical are the genitalia and the anus. Petrolatum strips are also used there.

When this treatment is used, the hazard of contamination is increased. However this has and is great in burns of these areas with any known treatment. It may be reduced by isolating the patient, by using sterile bed clothes, and by careful aseptic nursing procedures.

SECONDARY SURFACE TREATMENTS

The first pressure dressing or cast should be left in place for 2 or 3 weeks except in the few very superficial dermal burns that have probably healed prior to this time. A foul odor contamination of the dressing by urine or feces, and evidence of infection under the dressing should rarely be

considered indications for a change at any earlier time. If the dressing becomes loose or slips it should be repaired by adding more sterile material, new outside bandages, and new adhesive.

Changes of dressing should be made under aseptic conditions in an operating room. The patient should usually be prepared by a mild sedative. Anesthesia may be needed in rare severe chronic cases at many late dressings. Cyclopropane is the anesthetic agent of choice. On removal of the dressing the status of the wound is appraised and the further needs of the patient are estimated. Dermal burns will usually be healed in 2 weeks but deep dermal, mixed, and deep burns will be covered with soft foul slough. Purulent material and loose slough may be wiped off gently but no antiseptic solution should be used. In these cases some remaining slough will be present from 20 to 40 days. The second and all subsequent dressings should also be pressure dressings applied with the same technique described. As soon as large areas have become free of slough and if the granulations and the patient are both in good condition grafts should be applied without waiting for the adjacent slough to separate. In addition to the "chemical débridement" which will be described, many varieties of dressings have been suggested to speed the separation of the slough as well as to control infection. In general, every method, and this includes the one recommended here, has disadvantages as well as advantages. Frequent changes of dressings, wet, dry or with ointments, traumatize the wound and increase the danger of bacterial contamination, and the process of changing them is wearing to the patient. Antiseptic solutions or ointments may injure the granulations, the patient, or both and never eradicate infection. Pressure dressings applied to several extremities produce such immobility of the patient that he loses strength rapidly. On the other hand less confining dressings fail to control the pain from friction and allow more contamination. Both are weakening.

Tub baths and shower baths have been recommended (137). In general these are difficult to arrange and are infrequently used at present in the United States. A good method of providing continuous or intermittent irrigation with saline or Dakin's solution of the extremities has been devised by Bunyan. He uses a transparent plastic envelope that has two rubber tubes sealed into its sides. It is troublesome to use.

During the last years Levenson and associates (113) have abandoned all previous forms of secondary treatment and apply infrequently changed

dry pressure dressings or casts to the extremities and similar nonpressure dressings to the trunk. Even the use of frequently changed wet dressings just prior to grafting has been discarded (117). The only exception to this treatment of these areas is when very small scattered areas of granulation are left at the edges of the grafts. Under these conditions nonpressure frequently changed petrolatum dressings are used.

SKIN GRAFTING

Until the advent of the Padgett dermatome the technique of skin grafting burns of large area was difficult and was mastered by few surgeons. The simplest technique, but least satisfactory is that of Reverdin. Somewhat more difficult, but more satisfactory is that of Thiersch and much more difficult, but most satisfactory if successful, are the whole thickness graft and the pedicle graft. There is a great tendency particularly among surgeons who treat burns only occasionally to wait many months before doing any graft to allow nature to make its maximum efforts at healing. With such a *laissez-faire* policy burns adjacent to the joints lead to crippling contractures and deformities.

If Reverdin grafts are used early placed closely and tacked, they will grow out, cover large areas and at least in part, avoid contractures. However the skin surfaces (both recipient and donor) are always 'spotty' and seldom satisfactory. Expertly cut Thiersch grafts stretched to normal tension and completely covering a noncontracted granulating surface are much more satisfactory. In fact, the grafted skin approaches normal skin in appearance and function, and the donor site often becomes invisible.

Whole thickness grafts are of very little importance in the treatment of large burned areas. For small specialized areas, such as the eyelids, face and neck, they are essential, but the care of such defects is in the field of much more specialized plastic surgery than is within the scope of this review. The same is true of pedicled grafts.

1. Immediate excision and skin grafting

Immediate excision and skin grafting has been carried out by several authors (197). It is theoretically sound because after a deep burn is excised and the wound grafted, the area is healed in a week or 10 days. However it has a very limited applicability and is indicated only in obviously deep burns of very small area in which there is little likelihood of shock. Relatively few deep burns come in this category. Even with a small burned area the operation is a long one be-

cause of the difficulty of securing complete hemostasis.

B Delayed excision and skin grafting

Delayed excision and skin grafting has been carried out recently in a number of cases by Cope and Moore (46). It is their practice to give large amounts of penicillin intramuscularly and locally through Dakin's tubes incorporated into a pressure dressing at the time of burn. From 3 to 7 days later when the shock has been satisfactorily treated and the general condition of the patient is good the burned area is excised and grafted at one operation or grafted later within a few days. If the area is very extensive, the procedure must be done in stages. The same procedure, begun at a later date, between the tenth and fourteenth days, has been followed by Ackman and his associates (3). In their technique no parenteral chemotherapy is given but a sulfathiazole emulsion is used locally. The results of these procedures have been excellent, and the method has great promise in the hands of surgical teams experienced in dermatome grafting operations and in the care of surgical shock. Blood transfusions to the amount of several liters may be needed at the time of and immediately after these operations.

C Skin grafting after sloughing

Burns are grafted in most clinics in the granulating stage. The time when the slough is completely separated is usually between the third and sixth weeks. Sloughs on small and more vascular areas, such as the face, separate more quickly than those on larger and less vascular areas. Recently attempts have been made to speed up the time of separation of the slough by the application of various solutions such as the proteolytic enzymes, papain (41) or pepsin (100), or by the application of pyruvic acid in a starch paste (39) (chemical debridement). With the latter method the sloughs of deep dermal and deep burns may be removed in from 6 to 10 days without injury to any epithelium that may be present in the more superficial areas, or to the granulation tissue. Some very impressive results of its use in severe burns have been reported.

When the condition of the patient is satisfactory the granulations are firm and pink, and the chances of successful skin grafting are good. When unsatisfactory the granulations are edematous and friable, and the chances of successful skin grafting are poor. In most cases granulation tissue is not removed. However exuberant but firm granulations, if removed down to a firm yellow

low base, are no contraindication to grafting. Bleeding is controlled by warm saline packs or the application of thrombin (51).

D Technique of dermatome skin grafting

The Padgett dermatome (145) has many advantages over the knife or razor for cutting Thiersch grafts. Sheets of even thickness may be cut from parts of the body that could not otherwise be used as donor sites. Any thickness of skin, from 0.15 mm. to full thickness of the skin, may be taken. Grafts should be between 0.15 and 0.30 mm. thick. The amount of skin transferable at one operation is limited by the patient's general condition. Patients should seldom have more than four drums of skin grafted at one operation. Very sick patients can tolerate only two drums.

1. *Anesthesia.* Although it is possible to cut grafts after infiltration of the skin and subcutaneous tissue with procaine it is much more time consuming and difficult than to cut them under general or spinal anesthesia. Patients with extensive wounds do not tolerate either nitrous oxide and oxygen spinal or pentothal anesthetics well. Cyclopropane is much safer and is very satisfactory. Levenson and his associates (113) have used it in several hundred operations without any complication.

2. *Choice of donor sites.* Any part of the trunk, the whole circumference of the thigh or arm, and the posterior surface of the calf may be used as donor sites. Smooth areas on the thighs, chest, abdomen and back that are not too hollow or too sharply rounded are the areas most easily used. If the patient cannot easily remain prone for a few days, use of the back will cause post-operative discomfort.

3. *The operation.* Before the patient is anesthetized the dermatome knife should be inserted in its slot with the bevel away from the drum and its edge adjusted to cut the desired thickness of skin. This is done by setting the flange plate at zero and bringing the blade flush with the drum by turning the two adjusting screws at the sides. Then, turning the flange plate the required number of graduations will set the blade at the correct distance from the drum. The flange plate is graduated so that one division equals 0.025 millimeter. While the patient is being anesthetized the donor site is prepared with any standard method of skin preparation. If the wound dressing is removed at this time care must be taken not to contaminate the donor site, the instruments, or the team that will take the graft. After sterilization the donor site must be washed care-

fully with ether to make the skin absolutely dry. Then the drum is coated with an even thin layer of the special rubber cement that is furnished with the dermatome. Another layer of cement is then put on the dry skin. This is allowed to dry for from 2 to 3 minutes until it has lost its shiny moist appearance. The dermatome is then grasped in the surgeon's left hand with the back of the blade resting on his wrist. The distal edge of the drum is placed on the distal edge of the donor site and pressed down firmly for 1 minute. The edge is then raised about $1\frac{1}{2}$ centimeters by rolling the drum. The blade is then brought into contact with the skin by the right hand. Cutting is accomplished by short quick strokes of the blade while the left hand rolls the drum slowly toward the proximal edge of the donor site. The skin in contact with the knife should be under slight tension by being lifted by the adherent cement, while the skin about 3 centimeters proximal should be compressed by the drum. After from 1 to 2 centimeters have been cut an assistant should inspect the graft to determine its depth. If it is not correct the cut may be made thicker or thinner by moving the flange. This is done without removing either the drum or the blade from their positions. At times it may be necessary for the assistant to press down on the skin just lateral to the drum to keep this skin from interfering with the stroke of the knife or from being cut irregularly. When the proximal edge of the drum is reached the graft should be cut free with a separate scalpel. It is then picked up with small hemostats, peeled off the drum and laid on a sponge moistened with saline solution. Powdering the upper surface which is sticky from the rubber cement with sulfanilamide will make it much easier to handle. Other grafts are then cut if necessary. After all the grafts to be used are cut, the donor sites are covered with one thickness of fine mesh nylon or rayon and a few layers of gauze and towels to protect them from contamination during the remainder of the operation.

The area to be grafted is then uncovered, the skin around it sterilized and draped, and the wound surface is cleansed by applying moist sponges which are then removed without rubbing. The grafts are then laid on the wound in the largest possible pieces that fit. When the areas to be grafted are small or irregular in shape the grafts should be cut into pieces that fit. When ever possible, the grafts should come at least to the edges of the wound, and preferably they should overlap the edges slightly. Unless the method of using a "backed" graft, which will be described, is used, the graft should be stretched

to normal skin tension by sutures from 5 to 6 millimeters apart around its edges. A pressure dressing over the graft, which is strapped and bandaged into place so that it cannot possibly slip is essential. If the graft is on an extremity a plaster cast fixing the joints above and below the area grafted is also important.

The donor sites are now bandaged over the temporary dressing. If the donor site is on the anterior surface of the body arms, or legs, the whole dressing should be removed down to the single layer of nylon or rayon as soon as the patient is in bed. This should be exposed to the air to allow a dry scab to form which will protect the wound. This should be left in place until it falls off spontaneously after healing has taken place in 3 or 3 weeks.

4. Backing for dermatome grafts (78) The technique just described gives very satisfactory results but is time consuming because in order to stretch the grafts properly it is necessary to use a great many sutures. Usually the suturing is the longest part of the operation. When the grafts must be subdivided it is especially difficult to handle the pieces. Webster has recently shown that 'pilo film' may be used as a backing for grafts, and Evans (64) has suggested cellophane for the same purpose.

Before a graft with a backing is cut the drum is coated with dermatome cement and the backing film cemented to the drum as smoothly as possible. New coats of cement are then applied to the film and to the donor site and the graft is cut as described. The graft with its backing is removed from the drum and is placed on the recipient site. The backing prevents the normal contraction of the skin that results from its elasticity and gives it added strength. The handling of the cut skin is consequently much easier and any cutting of pieces to fit small or irregular areas is more easily performed. More important, however is the fact that no sutures are needed to maintain the graft at its original size and tension. The graft is maintained in place by even elastic pressure provided by a suitable pressure dressing. The backing is easily peeled off after the graft has healed.

Experience with cellophane as a backing material has shown that it is difficult to apply this substance to the dermatome without its wrinkling. Even very small wrinkles cause irregularity in the thickness of the graft. A more serious difficulty is due to the relative "stiffness" of the cellophane and the graft. When attempts are made to fit the cellophane backed graft to sur-

⁷⁸The film is the trade name of smooth plastic film that is relatively flexible.

faces that are convex, concave, or irregular wrinkling frequently results. This may lead to areas where serum or blood collects beneath the graft because of poor approximation to the granulations and over these areas the graft may be lost.

Fine gauge nylon¹ or similar rayon has proved to be more useful than cellophane. In the first place it never wrinkles on the dermatome drum. Secondly it sterilizes as easily as any textile and does not need special packing in the sterilizer to prevent adherence of its adjacent surfaces. It is unchanged physically after sterilization. In spite of its relative limpness before it is attached to the skin, it prevents contraction of the graft and sutures are unnecessary. Grafts backed with nylon conform better to irregular surfaces than do those backed with cellophane. In addition it has been found that it is possible to cut the skin from 0.15 to 0.20 millimeters thick. Such grafts are slightly thinner than those which can be successfully cut and handled without backing. The donor sites from which such thin grafts have been taken heal very rapidly and can be used again in a relatively short time. On all areas where split thickness grafts are satisfactory grafts of this thickness have given as satisfactory end results as slightly thicker ones.

E. Homografts

Homografting or the use of skin from some one other than the burned individual is in the nature of a temporary dressing since such grafts disappear in from 3 to 6 weeks. The only permanent homografts have been transplanted from one identical twin to another (23). The blood group as such appears not to have any important bearing on the success or duration of this type of graft. Homografting has a limited but definite application in the care of patients, particularly children with extensive burns. With the granulating areas covered, though only temporarily the general condition of the individual improves so that by the time the grafts dissolve autografts may be made. Ackman (2) has had a large series of cases in which these grafts were used successfully.

NUTRITION

As noted in the earlier section on nitrogen metabolism there are great early losses of nitrogen in the urine and losses from the surface of the burn until epithelialization is complete. The fact that low plasma protein levels and hypoproteinemie edema occurred late after burns was noted by

several investigators between 1930 and 1940. A fine report on this subject was that of Clavelin and Hugonot. There was very little of practical value that could be done at that time to improve the nutrition of their patient and an amputation had to be performed. When human plasma and serum became available they were used to combat this nutritional edema and following the attack on Pearl Harbor they had their first large scale clinical trial for this purpose. The results of plasma treatment of patients with edema were in no way as striking as the results of treatment of shock in burns. Plasma is inadequate as a means of combating the edema, which is a nutritional edema, because of the small amount of protein furnished by large amounts of plasma when compared to the needs of the organism. One liter of therapeutic plasma contains only about 50 grams of protein which as will be indicated is only a small part of the nutritional need of the patient with edema.

The estimation of the status of a burn patient with regard to the presence or degree of protein deficiency is not simple. The factors necessary for a critical evaluation are (1) optimum weight of the patient, (2) observed weight of the patient, (3) plasma protein level, (4) plasma albumin level, (5) plasma volume, (6) nitrogen intake and (7) nitrogen output. Actually, main reliance in clinical work has to be placed on a nutritional history on the patient's weight, and on serum protein determinations done most simply by some densitometer method.

Elman (60) was the first to stress the patient's weight in evaluating protein depletion. It is practical to weigh bedridden burn patients by weighing them on a stretcher at the time of dressing changes just before the dressing is removed and then weighing the removed dressing and the stretcher. As soon as a surgeon commences to weigh his patients with burns he will be amazed at some of the losses encountered in patients that do not have very severe burns. Losses of more than 25 kilograms have been reported as occurring in a few weeks after a severe burn in spite of efforts to maintain nutrition (178).

Failure to meet the increased nutritional demands of the severely burned patient results in progressive loss of weight and strength, edema, friable granulations, increased local infection and, finally, death from malnutrition. It is preferable to anticipate the requirements of the patient and to meet them before severe malnutrition occurs. In the very severely burned patient this may require as much as five or more times the normal intake of nitrogen. It has been indicated that the principal

¹This is the 55 gauge nylon cloth used for parachutes. It is not more than 1 millimeter thick and has a strength of 50 pounds per square inch in each direction. The warp is made of 40 Denier threads, 7 threads to the inch, and the weft of 40 Denier threads, 16 to the inch.

foodstuff required is protein. However, the food provided must be an adequate metabolic mixture containing in addition to adequate amounts of protein sufficient calories, carbohydrates, minerals, water and accessory food substances. Whenever possible, protein losses or deficiencies should be corrected by oral feeding. It is not enough for the surgeon to order a "high protein, high caloric, high vitamin diet." If such a diet is ordered the patient may fail to benefit from the order for any one of the following reasons: (1) the diet presented to the patient is not as specified; (2) the diet presented is not eaten in whole or in part because it lacks palatability; there is lack of appetite, and there is a lack of nurses to encourage eating; and (3) food eaten may be partly or wholly lost because of diarrhea or vomiting.

The three items listed under No. 3 are interrelated. It is common experience to find that a sick patient has no appetite. However, if special attention is paid to the likes and dislikes of the patient and special or other nurses are available to encourage eating and to offer meals when the patient desires them instead of only at stated routine periods, many such patients will eat a surprisingly large amount of food.

The two items under No. 3 are also related to each other. Forcing the diet in a sick patient does not always result in a net gain. Nausea, vomiting, distention, and diarrhea singly or together are limiting factors. In general the sicker the patient the less fat is tolerated, and the larger the proportion of protein that is required. It has been found that at least 25 per cent of the calories in the diet should come from protein and not over 15 per cent from fat if any of these intestinal symptoms have occurred recently. Some patients will need 50% of their calories in the form of protein. It is well to take a number of days to increase the food intake, as sudden increases are more likely to be followed by gastrointestinal symptoms. More cautious increases will prevent such symptoms. If the diet is not tolerated, protein in the form of a digest should be tried and frequently will be well tolerated. The available digests are not particularly palatable and should be given by intubation if refused by the patient.

Intubation feeding is important and may be used to increase the intake of food greatly. Medium caliber nasal stomach tubes are used and left in all the time or for many hours a day. If left in continuously the tube should be removed every third or fourth day for cleansing. About 500 cubic centimeters may be given at a time, spaced between meals and at night but there is a

wide variation in the amount and frequency of supplementary tube feedings that different patients will take. It is well to start with half skimmed milk and half water or with a mixture of protein hydrolyzate and carbohydrates and increase the strength and quantity of the mixture over a period of days. Instead of supplying the mixture in intermittent doses, a drip apparatus may be used which can, after a short period of training, be regulated by some of the patients themselves. If from 125 to 150 grams of protein and from 2,000 to 3,500 calories are given by intubation in addition to an average house diet, the patient should receive a total of about 200 grams of protein with over 4,000 calories.

Some of these patients will require protein and carbohydrate supplements given intravenously as well as by intubation. This has already been discussed by Tagnon and associates (173) and by Lund and Levenson (125) and by Elman (59).

CHRONIC ANEMIA

As noted in an earlier section there is an acute hemolytic process starting immediately after an extensive deep burn and continuing for about 72 hours. The actual number of red blood cells hemolyzed during this period is usually relatively small. However following this there is a chronic anemia which continues until healing is complete.

This anemia is progressive and its chronicity and severity are roughly proportional to the extent of unhealed deep burn. It does not respond to large intakes of iron, liver extract, protein, calories, and vitamins, although these must be given for nutritional purposes. Blood transfusions are necessary at frequent intervals and in large amounts to maintain the hemoglobin at a satisfactory level. In the past it has usually been recommended that the burn patient should be transfused with type specific blood when the hemoglobin falls below 75 per cent, but it has been learned that he does better when his hemoglobin is kept above 85 per cent. To accomplish this may require as much as 1 liter or more of blood every week during the patient's entire course of illness. If available, red blood cells suspended in saline solution are as satisfactory as whole blood (172).

The cause or causes of this chronic anemia are poorly understood. One factor may be chronic hemolysis. In support of this concept Moore and Cope (46) have found an increased excretion of red cell breakdown products. Emerson and Ebert recently demonstrated that pooled plasma and type O whole blood given to patients with types A, B or AB blood induces a persistent and severe

hemolytic process. This is detected by finding an increase in bilirubin in the plasma. Hemoglobinemia and hemoglobinuria are not found. Another factor in some cases is loss of blood into the dressings. This is particularly marked when the granulations are 'poor' and edematous in patients that are not in nutritional balance. The bone marrow is not markedly depressed as the reticulocyte count frequently reaches 5 per cent.

SEX HORMONES

In severe burns in young women menses cease and do not commence again until healing is nearly complete. At the same time these patients develop an abnormal growth of hair especially on their arms and legs. This hair disappears about the same time menses recommence (115-47). No similar change is noted in men. Attempts to treat the metabolic effects of burns with a growth promoting sex hormone (testosterone) in the early stages have not met with success (24-95). Recently following a suggestion made by Browne (24) testosterone propionate has been used with considerable clinical success in the late stages of burns at the Boston City Hospital. It was not possible to study the nitrogen excretion in these cases, but clinically they responded in a manner that indicated an increased positive nitrogen balance. The pain decreased, the granulations improved, the appetites increased, and weight was gained very rapidly. The dose used was 10 milligrams per day given intramuscularly. This hormone has given this good effect to patients of both sexes.

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ABSTRACTS OF CURRENT LITERATURE

SURGERY OF THE HEAD AND NECK

EYE

Donegan, E. A.: Ocular Findings in Tropical Typhus (Tautauganuah or Japanese River Fever) *Br J Ophth* 1946 30 11

Donegan reports the ocular findings in a series of 101 cases of tropical typhus or Japanese fever at the India Burma border. The disease is closely related to the louse-borne typhus which occurred during World War I (1914-18) in the Balkans and in Russia, and during World War II in Italy as well as the tick-borne typhus throughout the world. Rickettsia orientalis is the causative organism and its insect vector is a mite that is usually found where there is dead wood low scrub and rotting vegetation. Tropical rats and birds are the reservoirs of the disease.

Ninety-six West Africans and 6 Europeans were affected. The patients usually presented headache, apathy, enlargement of the spleen and liver, pulmonary congestion, hyperemia of the conjunctiva, blurring of the margins of the optic disc, optic neuritis and hardness of the vitreous. Many cases showed evidence of the descending neuritis described by von Graefe which disappeared without residual damage to the optic nerve or retina.

There were only 2 cases of optic atrophy in the present series 1 of which was syphilitic. The mortal rate was 4 per cent. JOSEPH ZUCKERMAN M D

Paul M.: Cavernous Hemangioma of the Orbit Successfully Removed by Shingue's Operation *Br J Ophth* 1946 30 35

The author describes a cavernous hemangioma of the orbit which was successfully removed by Shingue's method of operation which involves an approach to the lateral wall of the orbit beneath the zygomatic bone removal of the lateral orbital wall and removal of the tumor. The major complication of this operation is the possibility of injury to the lateral rectus muscle. The advantage is in the adequate exposure of the tumor which does not interfere with the future function of the eye. In the author's case removal of the tumor gave a satisfactory result.

HOWARD H. ROBERTS, M D

Meenan, P N.: The Etiology of Trachoma in Ireland (Preliminary Communication) *Iris J Med Sc* 1945 839 370

The author discusses the etiology of trachoma in Ireland, where it has recently become prevalent. He points out that trachoma causes approximately 9 per cent of the cases of blindness in Ireland but only 0.81 per cent in Scotland.

At present, the causal agent of trachoma is considered to be either a rickettsia or a virus. There is some evidence in favor of the rickettsial theory. Typical rickettsias are not filtrable and they confer immunity.

There is also evidence in favor of the virus theory which was advanced in 1907. The infective agent is filtrable. The presence of inclusions composed of elementary bodies constitutes the earliest recognizable change in trachoma and is demonstrable in all cases at their onset.

Whether viral or rickettsial in origin these bodies are considered the causal agent of trachoma. They are morphologically indistinguishable from those of psittacosis inclusion conjunctivitis and lymphogranuloma venereum. The virus has never been grown in the laboratory. Infection with trachoma does not confer permanent immunity.

It seems that the Castaneda positive viruses are closely related. They may all have a common ancestry and the specific differences may have been acquired by prolonged residence in a particular animal species or tissue. JOSEPH ZUCKERMAN M D

Pereira R. F. and Tolosa, E. E.: Dacryocanalitis Simulating a Dacryocanalicularitis (Dacryoductitis simulando una dacriocanalicularitis) *Sem med. B Air* 1945 55 893

The author describes a rather remarkable case in which pus from the ethmoid cells was draining through a fistula from the involved sinuses and then through the superior lacrimal canal into the right eye.

Fluid instilled into the incised inferior lacrimal canal which contained a slight amount of pus passed readily into the nasal cavity apparently through the normal opening into the nose then the superior canal was incised but no pus could be expressed from the lacrimal sac. A probe was passed into the nasal cavity in the region of the ethmoid cells and its position verified with x rays.

The patient was now referred to the ear nose, and throat department, where the condition was diagnosed by direct examination as hypertrophy of the right superior turbinate due to edema of the meatus on the right side and by roentgenography because of the opacity of all the sinuses on the right side—especially the ethmoidal and maxillary—as a maxillo-ethmoidal sinusitis. An operation designated as that of Ermiro de Lima was performed. This operation permits supervision of the maxillary sinus and at the same time gives access to and permits evacuation of the entire ethmoid system. At this operation there was encountered intense hyperplasia of the

mucosa of the ethmoid cells. These cells were full of fetid pus and their intercellular walls were broken down.

In a few days the patient had healed normally with disappearance both of the secretion into the conjunctival sac, and of the fistulous opening into the nose. Re-examination a few months later disclosed complete absence of all signs of infection of the nose and eye. Fluids passed normally into the nose through both the superior and inferior lacrimal canals and the probe could no longer be passed through the fistulous opening into the ethmoid region of the nose.

JOHN W. BARNARD, M.D.

De Roethth A.: Hypofunction of the Lacrimal Gland and the Sjögren Syndrome. *J. Lencet* 1945, 68: 423.

The author states that diminished lacrimal secretion may be due to congenital absence surgical removal, or destruction (by radiation) of the lacrimal gland, the presence of toxins, and endocrine dysfunction.

The most marked form of hypofunction is known as filamentary keratitis. The condition is characterized by epithelial filaments which present knobs at their free ends. The less marked type is called keratoconjunctivitis sicca, which presents a stringy,ropy mucoid discharge, photophobia, burning, grittiness, round gray epithelial dots, and xerosthemia of the cornea. The Schirmer test shows only from 3 to 6 mm. of moistening in 5 minutes.

Another type of hypofunction occurs as part of the Sjögren syndrome in association with dryness of the mouth, nose, and larynx, due to decreased function of the salivary glands. About 50 per cent of patients with this type of hypofunction have chronic arthritis.

The mildest form of hypofunction is difficult to recognize. It is characterized by vague symptoms such as fatigue or heaviness of the eyes, dryness of the nose and mouth, and difficulty in reading especially by artificial light. However the Schirmer test is positive.

Therapy consists in occlusion of all the puncta, the instillation of tear substitutes such as sodium chloride, egg albumin, liquid petrolatum, fibrolysin or Gifford's solution, the administration of ovarian extract, and the removal of foci of infection.

JOSEPH ZUCKERMAN, M.D.

Hymes, C.: Scleral Flap Incision with Scleral Sutures for the Cataract Operation. *Arch. Ophth.*, Chic., 1945, 34: 374.

The author describes a method of cataract extraction in which a scleral flap incision is made and scleral sutures are used.

After retrobulbar injection anesthesia and akinesia of the orbicularis muscle, a superior rectus muscle suture is inserted for retraction of the eyeball. A conjunctival flap is dissected 3 mm. above the upper limbus, and a concentric wedge shaped scleral flap with its base at the limbus, is then made with the

use of a Lundgaard or Hymes concave knife. This is started at about 1 to 3 mm. above the upper limbus and the conjunctival flap is left attached to it. The corneal section is then made with a keratome and enlarged with scissors. Before extraction of the cataract, a single suture is inserted—first through the conjunctiva, then through the lower lip of the sclera, the upper lip of the sclera, and finally through the upper lip of the conjunctiva. The loop is laid aside. After the cataract has been extracted the suture is pulled taut, and tied.

The author is of the opinion that with this procedure, a firmer and more accurate closure of cataract wounds is obtained and the incidence of post-operative complications and of astigmatism is reduced.

JOSEPH ZUCKERMAN, M.D.

Chamlin, M.: The Effect of Talc in Ocular Surgery. *Arch. Ophth.*, Chic. 1945, 34: 369.

The author discusses the effect of talc (generally used on surgical gloves) on the ocular tissues.

In a series of experiments on the eyes of rabbits he simulated the accidental introduction of talc into the ocular tissues during surgical procedures. He found that talc produces foreign body granulomas in most eyes.

To avoid this undesirable possibility, he recommends directing a stream of saline solution from an irrigator at the surgeon's gloved hands before operation, instead of immersing them in saline or other solutions.

JOSEPH ZUCKERMAN, M.D.

RAR

Conley J. J.: The Treatment of Chronic Suppurative Otitis Media with Penicillin. *Arch. Otolaryng.* 1945, 4: 374.

Penicillin therapy is of little help in patients with chronic suppurative otitis media which has proved resistant to sulfonamide compounds. The response of chronic suppurative otitis media to systemic treatment with sulfadiazine followed by 1,000,000 units of penicillin is insignificant. The response of chronic suppurative otitis media to local penicillin therapy is good. 55 per cent of the cases treated were definitely improved. Granulation tissue and cholesteatomas are not affected by sulfadiazine or penicillin, whether administered generally or locally.

The best treatment for acute and chronic suppurative otitis media is to prevent their occurrence by the prophylactic use of one or both of the chemical and biological therapeutic agents.

NOAH D. FABRICANT, M.D.

Moreira, D.: Gradengio e Syndrome (Sindrome de Gradengio). *Fol. med. Rio.*, 1945, 56: 46.

The author reports on a patient with a syndrome consisting of acute otitis media, neuralgia of the trigeminal nerve, and paralysis of the sixth pair of cranial nerves, which was first described by Gradengio of the Royal Academy of Turin in 1904 and since then known under his name. This is the tenth case

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reported in the Brazilian literature and possibly the first from Brazil with contralateral paralysis.

The patient was a Brazilian mulatto 30 years of age who had atrophic rhinitis and upon admittance had been suffering with a suppurating left ear for about 20 days. After repeated myringotomy and intensive treatment with 4 and later 3 gm. per day of sulfanilamide the condition improved, but some-what over a month later intense temporal and retrobulbar headaches occurred and paralysis of the abducens nerve developed all on the right side. At no time did otoscopy or roentgenography show any evidence of changes in the right ear or other (mastoid or petrosal) regions. There was some doubt at this time of any changes in the mastoid cells of the left side and there was a slight mucoid discharge from the left ear but nothing suggested the sudden change in the patient's condition.

Treatment with sulfanilamide combined with antipyretic vaccine and vitamin B was instituted and 3 months later the patient was entirely well, and 5 months later the patient was entirely normal.

An interesting coincidence was the sudden occurrence of fever about 10 days before recovery with the discovery of plasmodium vivax in the blood. Altogether, the patient had undergone 8 myringotomies and received 15 ampoules of antipyretic vaccine 418 milligrams of vitamin B and 51.75 grams sulfanilamide.

JOHN W. BRENNAN, M.D.

NOSE AND SINUSES

Cenget, D. D., Poser, R. A., and Soet, A. Rhinosporidium Seebertii Granniloma. The First Case in Tucumán (Primer caso en Tucumán de granuloma por rhinosporidium Seebertii). *Arch. farm. biol. quim.*, Tucumán, 1945, 2: 19.

The authors report a new case of granuloma produced by the rhinosporidium Seebertii, the seventh case reported in Argentina, and the first found in Tucumán. It shows a geographic zone so far unknown with regard to this parasite.

This parasite is a fungus of the order of the chytridiales, belonging to the diploidiaceae family. The mechanism of human infection as well as that of infection of possible intermediary hosts is unknown. The fungus produces a chronic inflammatory hyper trophy which results in polyps of the nasal mucosa. Photographs of microscopic sections in the original article show all the developmental phases of the parasite.

HENRIQUE LANA, M.D.

Peor, L. A.: The Neglected Septal Cartilage Graft with Experimental Observations on the Growth of Human Cartilage Grafts. *Otolaryng.*, Chic., 1945, 41: 384.

The general belief that autogenous septal cartilage grafts do not survive after transplantation alar cartilage, lateral cartilage, and rib cartilage all survive after transplantation as living purposes. Autogenous sep-

tal cartilage is superior to alar and auricular cartilage only because of its greater bulk and firmer structure. It is superior to rib cartilage because it is more readily obtainable. Autogenous septal cartilage should be used whenever a nasal defect can be adequately supported by the patient's septal cartilage with the addition of septal bone when necessary.

When the nasal depression is sufficiently large to require rib cartilage, autogenous cartilage is the material of choice. Preserved cadaveric cartilage may be used in debilitated or elderly patients. Experimental observations indicated actual growth of young human annular and septal cartilage increased. The more bulky young rib cartilage grafts increased in some cases and in others showed no increase in size. Septal bone grafts without periosteum transplanted beneath the abdominal skin retained their normal bone structure for periods up to 4 years after transplantation. Rib and tibial bone, with and without periosteum transplanted beneath the abdominal skin completely disappeared 7 months after trans-plantation.

NOAN D. FABRICANT, M.D.

Berger, M. D.: Neoplasms of Both Maxillary Sinuses. *Arch. Otolaryng.*, Chic., 1945, 41: 397.

Because of the apparent rarity of cases in which both maxillary sinuses were invaded by neoplasms a careful scrutiny of the literature was undertaken in order to determine whether any such case had been previously reported. During the past 20 years there has been no report of a case of bilateral neoplastic involvement of the antrums. The author observed cancerous involvement of the two maxillary antrums in a patient 62 years of age. The neoplasms were separate and distinct entities. The second growth developed while the patient was under observation.

NOAN D. FABRICANT, M.D.

PHARYNX

Morley, J. Pharyngeal Diverticula. *Brit. J. Surg.*, 1945, 33: 101.

The author presents 21 cases of pharyngeal diverticula treated by one stage resection and suture. Two cases of pharyngeal diverticula complicated by squamous epithelioma originating in the pouch are recorded.

Hunt's anterior pharyngoesophageal pouch is demonstrated with the aid of barium in the vallecula between the tongue and the epiglottis.

The technique and results of the one stage excision operation are described and its advantages as compared with resection in two stages are set forth.

JOHN F. DUNN, M.D.

NECK

Leeson, M. F. and Gargill, B. L.: Thyrocarcinoma as a Cause of Neutropenia and Agranulocytosis. *N. Engl. J. Med.*, 1945, 233: 803.

The authors treated 62 patients with thyrocarcinoma. Of these, 61 had thyrotoxicosis and 1 had angina.

pectoris. Five patients developed neutropenia and granulopenia. Of these 1 (with thyrotoxicosis) died of agranulocytic angina; another of the 3 patients developed a sore throat but recovered; 1 patient, with granulopenia, recovered with continued administration of thiouracil.

Fifty-four cases reported in the literature, and 3 personal cases of neutropenia following the administration of thiouracil, are classified in 3 groups, as follows:

Group 1 includes 36 cases of asymptomatic neutropenia and granulopenia (often confused with the mild neutropenia and lymphocytosis of toxic goiter); group 2 includes 11 cases of significant neutropenia, frequently associated with symptoms, especially fever and pharyngitis, which readily subsided on discontinuance of the drug; the patients sometimes recovering with continuation of the drug; group 3 includes 8 cases of severe granulopenia, many with a typical picture of agranulocytic angina, and 4 of which ended fatally.

The authors discuss the relative benefits and dangers of thiouracil therapy as compared with the dangers of thyrotoxicosis and thyroid surgery. They point out that whereas most deaths following thyroidectomy are in patients with severely toxic goiters, thiouracil may cause the death of patients with mild thyrotoxicosis.

In analyzing the possible mechanisms of thiouracil neutropenia, the authors state that marrow biopsies indicate both destruction of mature granulocytes and inhibition of the development of promyelocytes.

Hypersensitivity appears to be the conditioning factor in the production of granulopenia with thiouracil. Thiouracil definitely falls into the group of drugs that produce allergic manifestations—namely, drug fever, urticarial and other types of skin eruptions, and reproductions of toxic symptoms with readministration in small doses."

Thyrotoxicosis seemed not to be a factor in agranulocytosis due to thiouracil since it occurs in the absence, and during remissions, of thyrotoxicosis. Dosage and duration of treatment also seemed to be not important.

Both acetalization and desensitization have been observed.

Patients who receive thiouracil must be under constant supervision. Since the onset of neutropenia and agranulocytosis is not detectable without blood counts, it is recommended that white cell counts be made three times weekly. The authors advocate the following treatment of agranulocytic angina associated with thiouracil: withdrawal of the drug, blood transfusions, and the administration of penicillin, liver extract, pentonucleotide, and yeast.

CARROLL H. THURMAN, M.D.

Lora, J. M.: Stripping of the Vocal Cords. *Arch Otolaryngol.* 1945 42: 378.

Experimental stripping of the vocal cords in cats established the fact of vocal cord regeneration. Application of this operation to the human larynx confirmed the experimental findings.

All types of benign lesions lend themselves to the stripping operation. Hyperkeratotic papilloma can be cured by this operation.

General anesthesia supplemented by local anesthesia induced by the application of a solution of such anesthetic drugs as cocaine hydrochloride or tetracaine hydrochloride is the anesthesia of choice.

The operative technique has proved satisfactory. The postoperative management with silence or the whispered voice is questioned. Better end results have been obtained by permitting reasonable use of the voice. Functional results have been good.

The satisfactory results obtained warrant the continued application of the principles of this operation.

NOAH D. FARBACANT, M.D.

SURGERY OF THE NERVOUS SYSTEM

PERIPHERAL NERVES

Toinick, B., and Beck, W. C. The Histamine Flare in the Emulsiion of Peripheral Nerve Lesions. *War Med.*, Chic. 1945 8 386

As an adjunct to other objective tests in the diagnosis of peripheral nerve lesions the authors advocate and describe the histamine flare test. The test consists of an intradermal injection of 0.1 c.c. of a 1 to 1,000 solution of histamine phosphate in the affected extremity and as a control test on the unaffected side. The small red reaction it has on injection and the wheal which follows it have no diagnostic importance. The flare comes later and its intensity and dimensions vary. It depends on intact arteriolar circulation and on an intact axon reflex. Thus the presence of a flare will indicate that both the local nerve supply and the local blood supply are present, and the absence of a flare will indicate that either the blood supply is absent or the peripheral nerve supplying the area has undergone degeneration.

From their limited observations the authors suggest that in the absence of a flare the nerve is completely divided and requires early surgical repair. They interpret the appearance of a partial flare as due to a concussion or edema of the nerve, for which recovery will be spontaneous without operative intervention.

The presence of the histamine flare being entirely dependent on the degeneration of the axon, it may also be an objective test in the differentiation between the hysterical and the organic anesthetics. It may also be of value in the differential diagnosis of hysteria and malingering. The injection of histamine is painful and the malingering will almost always give evidences of pain or of pruritus.

GEORGE PERRET, M.D.

BRAIN AND ITS COVERINGS CRANIAL NERVES

Grunnagle, J. F. Early Treatment of Open Head Wounds. *War Med.*, Chic., 1945 8 376

The author's article deals with his experience in the treatment of open head wounds in a general hospital during a period of 7 months in the Philippine campaign. Forty per cent of the patients suffered infections of various types, and the mortality was 1 per cent.

The objectives in the treatment of cranio-cerebral injuries are the preservation of life, the preservation of function and the prevention of infection. The elimination of infection will do much toward the accomplishment of the two other objectives and prevention will depend almost entirely upon the application of sound first aid measures and the early definitive surgical repair.

The first aid measures include, mainly the treatment of shock and the loss of blood, drainage of a distended urinary bladder, the institution of systemic sulfonamide and penicillin therapy, shaving and cleansing of the scalp, the application of a large sterile dressing, the administration of tetanus toxoid, and prompt evacuation of the patient to a hospital equipped for definitive surgical intervention on such wounds.

The optimum time for debridement is within the first 6 hours following injury but it can be done after a longer interval has elapsed if adequate penicillin and sulfonamide therapy have been instituted. Debridement of all involved tissues, and closure of the wound without drainage as the best means of preventing infection. All patients in whom the scalp had been debrided and left open and a sulfonamide dressing had been degrees of infection and closed, with varying degrees of infection and closed, scalp wounds which had been debrided and some of them had been broken down. On the other hand all wounds which had been debrided and closed tightly without drainage had healed with no evidence of infection, which proved the efficacy of that method of treatment. The author believes that the same principles should be applied in the treatment of fractures of the skull. He emphasizes the importance of the removal of all foreign material, fragments and contaminated bone cases in which the dura had been torn showed severe and extensive damage as the result of infected cerebral herniations, meningitis or brain abscess in addition to osteomyelitis of the skull and cellulitis. Neither herniation nor infection occurred in patients in whom early and adequate debridement and closure had been accomplished. The author states that if necessary closure of the dura can be obtained by the use of a graft taken from the sheath of the temporal muscle, pericranium, or fascia lata. The same observations were made following the treatment of more extensive cerebral tissue, bone fragments blood clots, and debris by careful irrigation and suction is allacerated debrided. Closure of the dura, to avoid cerebrospinal fluid (without associated lacerations) recommended. Closure of the primary importance of cerebral pressure was treated by the use of a graft taken from the sheath of the temporal muscle, pericranium, or fascia lata. The same observations were made following the treatment of more extensive cerebral tissue, bone fragments blood clots, and debris by careful irrigation and suction is allacerated debrided. Closure of the dura, to avoid cerebrospinal fluid (without associated lacerations) recommended.

The author believes that penicillin and sulfonamides should be given to all patients with severe

cranio-cerebral injuries, but that the use of these drugs does not replace proper and early surgical débridement and repair. Drains offer a pathway for the entrance of infection and should therefore be avoided. Tight closure of the débrided wound is the best safeguard against infection.

GEORGE FERRIS, M.D.

Wycis, H.: Bilateral Intracranial Section of the Glossopharyngeal Nerve; Report of a Case. *Arch. Near Psychol. Chlc.* 1945, 34: 344.

This brief article gives a concise review of the surgery on the glossopharyngeal nerve and a résumé of the effects of the glossopharyngeal nerve on the carotid sinus mechanism.

A case report is given of a patient who was operated upon with bilateral section of the glossopharyngeal nerve for the pain of carcinoma of the epipharynx. On section of the nerves a dramatic rise in blood pressure, pulse and respiratory rate was noted, whereas previous to operation these figures had been at a normal low level, the carotid sinus had not been sensitive to manipulation, and the electrocardiogram was normal. The pulse and respiratory rate remained high for 3 days, and the hypertension persisted for 4 weeks not reaching the preoperative levels until 5 days prior to the death of the patient, when there were signs of circulatory failure. The patient died of suppurative pneumonitis 1 month after operation due, not to inability to swallow because of the section of the glossopharyngeal nerves, but dysphagia, but rather to a constantly sloughing epipharyngeal mass which discharged continuously into the lower pharynx. In and of itself bilateral section of the glossopharyngeal nerve is compatible with normal life.

JOHN MARTIN, M.D.

Woolf, J. I.: Acute Hypertension with Sodium Pentothal Anesthesia in Neurologic Surgery. *Ann. Surg.* 1945, 124: 1146.

Acute arterial hypertension which occurs during the subtemporal approach to the gasserian ganglion has been reported when sodium pentothal anesthesia is used. This rise in blood pressure is well defined and in a consecutive cases averaged 51.3/38.5 mm. of mercury.

A similar rise in blood pressure did not occur when ether anesthesia was used.

Further studies were conducted upon patients operated upon for herniated intervertebral discs under sodium pentothal anesthesia. No elevation of the blood pressure could be demonstrated.

It was also noted that the final blood pressure was higher in both the dislocated intervertebral disc series as well as the gasserian ganglion series when anesthesia. It was therefore suggested that post-operative shock was less likely to occur under such anesthetics.

It is not possible to give an entirely satisfactory explanation of the acute hypertension noted ex-

clusively in the patients operated upon for section of the sensory root of the gasserian ganglion. It is suggested that there may be a hypersensitivity of the cerebral vasomotor centers under pentothal anesthesia. Retraction of the temporal lobe may result in widespread pressure or irritative effects although the site of vasomotor stimulation is not known.

No untoward effects were noted as the result of this temporary hypertension during surgery.

HOWARD A. BROWN, M.D.

SPINAL CORD AND ITS COVERINGS

Shenkin, H. A., Horn, R. C., Jr., and Grant, F. C.: Lesions of the Spinal Epidural Space Producing Cord Compression. *Arch. Surg.* 1945, 51: 1185.

The authors review the spinal extradural compressive lesions encountered in a 10 year period (1934-1944) in the material of the Laboratory of Neurosurgical Pathology of the Hospital of the University of Pennsylvania. These formed a series of 54 cases and comprised roughly 3 per cent of the total lesions are classified pathologically and described.

Metastatic carcinoma was proved in 9 cases. Of these, 8 patients were over 50 years of age, and 1 (a man with a probable primary kidney tumor) was 27 years of age. Symptoms of root compression appeared first, followed usually after a period of several months, by cord compression. Progression was rapid and the systemic nature of the process was suggested by weight loss. Roentgenograms showed vertebral erosion. In 6 of the 9 cases the primary site of the lesion was never determined. In addition to the kidney tumor primary carcinoma of the lung was discovered in 3 cases. Decompression gave relief of pain but failed to relieve the symptoms of cord compression.

All of the tumors were friable and encased the dura. The laminae and spines were extensively involved. Five of the lesions were adenocarcinomas, 3 were squamous cell epitheliomas, and 3 were undifferentiated.

In 7 patients in the fifth to seventh decades of life, myelomas were found. All patients had symptoms of a sudden onset of cord compression. Roentgenograms showed vertebral erosion and complete spinal subarachnoid block. In one-half of the cases there were symptoms of premonitory root irritation. Complete studies were made in 4 of the cases and in only 1 case was the vertebral lesion shown to be an isolated one. There were no alterations in serum proteins and the presence of Bence Jones protein in the urine was not observed in the 3 cases in which these examinations were carried out.

The epidural mass found at operation was extremely vascular. The tumors were composed of closely packed masses of cells resembling plasma cells. As a group, the patients succumbed rapidly the longest survival being 14 months.

Six cases of neuroblastoma (sympathicoblastomas) were found. Three of the patients were between 9

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and 33 years of age and the remaining 3 were 6 months, 22 years and 67 years of age. The two older patients had had pain for a period of 6 months prior to cord compression, the duration of pain in the other 4 patients had been less than 1 month. Roentgenological evidence of vertebral involvement was noted in 2 cases, a retroperitoneal mass was present in 4 cases and a posterior mediastinal tumor in 1 case. The tumors appeared bluish red and very vascular and tended to infiltrate into the paravertebral muscles. The majority of the tumors were located in the lower dorsal and upper lumbar regions. The six-months-old infant is living 1 year after operation, and has shown some neurological improvement, the other 5 patients are dead.

The histological appearance of the tumors was that of solid cord or small nests of tumor cells separated by delicate fibrous bands. The nuclei were usually stained with scanty cytoplasm. Silver stains showed delicate reticulin fibrils. Some of the tumors showed larger cells with nuclei containing clumps of chromatin. These were thought to be sympathoblasts as described by Ris and Geschickter. In 1 case the tumor may have been primary in bone. In the other cases it seemed to have invaded the epidural space from the retroperitoneal space or the posterior mediastinum.

In 3 patients, giant cell tumor of the bone occurred during the second decade of life. All 3 had root first as the first symptom, followed after a period of several months by the abrupt onset of cord compression with rapid progression of symptoms. All lesions were in the midthoracic region, and roentgenograms showed bony erosion. There was no history of trauma. At operation the authors found an encapsulated tumor mass usually not connected with bone. All 3 patients are well after surgical curettage and postoperative irradiation after 2, 3 1/2 and 9 years respectively. The tumors were composed of giant cells scattered in a vascular and cellular stroma. These cells were of the same type as those seen in giant cell tumors of the bone. The sections of 1 of the lesions showed extensive new bone formation. In the group of lymphosarcoma occurring in the group of miscellaneous neoplasms as their first symptom. In both cases the gross and histological appearance of the tumors were characteristic. In 10 and 10 months after operation, followed by intensive irradiation, both patients are in good general condition and able to get about with the aid of canes.

One case of lipoma in a 45 year old patient, and 1 case of liposarcoma in a 48 year old patient are reported. In the former there was a slowly progressive paraparesis with no symptoms or signs of root involvement, and surgical decompression was followed by complete recovery. In the latter root pain for 1 month was followed by complete paraplegia which developed in 24 hours. At operation a red beefy

mass involving the eighth thoracic vertebra was found. The patient was unimproved by operation.

An encapsulated hemangioma caused progressive weakness in a 54 year old woman. This was completely removed and the patient made a full recovery. Another blood vessel tumor a malignant hemangiopericytoma metastasized to the epidural space from the thigh in a 43 year old man. His symptoms were not relieved by operation and death occurred after a period of 5 months.

In a case of acute monocytic leucemia in an 18 year old girl leucemic infiltration caused root pain and rapidly progressive quadriplegia. Death occurred on the ninth day after operation. One completely extradural neurilemmoma was found in a 52 year old woman who had had symptoms of cord compression and root pain for a period of 7 months. At operation the tumor was only partially removed and the patient had a recurrence of several months however, there was a recurrence of the tumor and the patient finally succumbed to sepsis.

There were 2 unclassified tumors one of which closely resembled a hemangioma, the other a malignant neurilemmoma. In 2 of the patients in this series spinal extradural cysts were present. These were characterized by aplastic paraparesis and loss of position and vibration senses in the legs. Roentgenograms showed a uniform erosion of the pedicles. Following operation removal of the cysts both patients made complete recoveries.

Chronic epidural hematoma caused cord compression in 2 patients. Neither of these patients had any history of trauma, and the onset of symptoms was very sudden. At operation the lesions appeared similar to those of an intracranial subdural hematoma. Following decompression 1 patient was completely well the condition of the other patient was unimproved. There was 1 case of acute epidural hemorrhage following trauma. This patient was not benefited by operation.

There were 6 cases of acute epidural abscess. The onset of symptoms was sudden and the progression rapid in all cases. The source of the infection and the organism (hemolytic staphylococcus albus) were easily determined. The abscesses were very extensive and only 1 patient was benefited by operation. Two patients with tuberculous granuloma were operated upon. In each of these the indications for operation were symptoms of cord compression since tuberculosis was not proved until after operation. A diagnosis of tuberculosis usually contraindicates laminectomy.

Three cases of syphilitic gumma of the epidural space were observed. The Wassermann reaction of both the spinal fluid and the blood of all patients was positive. Except for root pain and cord compression caused by the gummas, these patients were free of symptoms of syphilis. All were given antiluetic therapy postoperatively and all were completely relieved of symptoms.

The authors series also includes 3 cases of non-specific granuloma. The symptoms were slowly progressive in all of the patients. Only 1 of the 3 was benefited by operation. ROBERT E. GREEN, M.D.

MISCELLANEOUS

Walker, A. E., and Johnson, H. C.: Principles and Practice of Penicillin Therapy in Diseases of the Nervous System. *Ann. Surg.* 1945, 2 1185

Although systemic penicillin appears in the spinal fluid in only minute quantities when injected into a normal animal or person, the amounts are materially increased and will be sufficient to cause bacteriostasis for the more sensitive organisms when meningeal irritation, caused either by sterile media (such as air in pneumoencephalography) or by bacterial invasion, is present.

In intrathecal administration of the drug, the best diffusion and the highest levels are found in intraventricular injection. Injection into the cisterna magna gives the next best results and injection into the lumbar subarachnoid space the poorest. Both of the former routes are too dangerous for any but very extraordinary cases.

Intrathecal penicillin can produce toxic effects on the nervous system. Twenty thousand units in 1 c.c. of saline injected into an experimental monkey produces transient perianal paresthesias, and in some cases convulsions, coma, and death. A patient who was given 100,000 units of penicillin in 5 c.c. of saline developed urinary retention, saddle paresthesias, and paraparesis. It required 3 months for these symptoms to clear up. Neymann has re-

ported 2 cases of convulsions, coma, and death when 50,000 units of penicillin were injected into the cisterna magna of patients with dementia paralytica. Convulsive manifestations are more likely to follow intraventricular injection of the drug, or its topical application to the cerebral cortex.

In the treatment of specific disease, penicillin should not be used for meningococcus meningitis unless sulfadiazine fails to yield improvement in from 24 to 48 hours. In this disease, intramuscular penicillin (40,000 units every 3 hours) should be used.

For streptococcal meningitis, intrathecal as well as systemic infection is required. This is also the case for staphylococcal meningitis.

In the treatment of pneumococcal meningitis, a disease that was uniformly fatal before the advent of chemotherapy, sulfadiazine plus both systemic and intrathecal penicillin should be used.

In the surgical treatment of compound fractures of the skull, from 5,000 to 20,000 units of either dry or aqueous penicillin may be placed in the wound in addition, systemic penicillin should be given.

Before a brain abscess is drained, systemic penicillin (100,000 to 300,000 units) should be given daily. At the time of drainage 1,000 to 20,000 units may be instilled into the cavity.

Infected meningococci and meningomyelococci respond well to penicillin therapy.

Penicillin has a favorable effect on early neurosyphilis, but tuberculous meningitis, brain tumor, multiple sclerosis, amyotrophic lateral sclerosis, and cerebral degeneration are unimproved by the drug.

ROBERT E. GREEN, M.D.

SURGERY OF THE THORAX

CHEST WALL AND BREAST

Govan A. D. T.: Two Cases of Mixed Malignant Tumor of the Breast. *J. Path. Bact., Lond.*, 1945, 57: 597

The following 2 cases of mixed malignant tumor of the breast were reported not only because of the rarity of these growths but also because the histological diagnosis appears to be unusually precise and the similarity of the case histories and subsequent development makes them of clinical interest.

The patients were admitted to the Queen Elizabeth Hospital, Birmingham, England. Their ages were 37 and 47 respectively. They both complained of a progressive swelling of the breast which developed a discharge from the nipple. Examination revealed an enlarged nodular (cystic) breast which was mobile. No other pathological conditions were elicited.

No other patient was treated by excision of the breast. One patient was treated by deep x-ray therapy. The other was followed by a mastectomy followed by x-ray therapy. Both patients made an uneventful postoperative recovery and were discharged to the hospital shortly after their discharge, the first patient complaining of a lump in the axilla and the second of a lump in the incision. The patients received further surgical and x-ray therapy. Death occurred a few months later. Secondary metastases to the lungs and spine were found.

Laboratory examination revealed the growth to be well circumscribed and in parts almost encapsulated. It could be divided roughly into cystic and noncystic parts which gave the tumor an irregular lobulated appearance. The cysts were formed by hemorrhagic. They might well have been formed by necrosis of and hemorrhage into parts of the tumor. The neoplastic tissue consisted of solid white, fleshy masses bearing little resemblance to the usual carcinoma growths of this region. There was no suggestion of irregular or widespread infiltration of the normal tissue such as one finds in carcinoma. At all points the growth was clearly demarcated from the normal breast tissue.

It was at once evident on microscopic examination that two types of growth, carcinomatous and sarcomatous, were present. The carcinoma could be seen to have originated in the main ducts. It was absent from the tissue surrounding the hemorrhagic cysts and from the lobulated masses at the periphery. Here and there smaller and more irregular islands of carcinoma could be seen in the central portion but always well defined and clearly differentiated from the second type of growth.

It must remain in doubt whether the sarcoma or the carcinoma was the cause of the metastases which were undoubtedly present. There was, however, no evidence of lymphatic permeation and the subse-

quent history is one of early local recurrence with later metastases to the lungs and bones via the blood stream. These facts would suggest that it was the sarcoma which had disseminated, and indeed it would seem unlikely that a well differentiated carcinoma with relatively few mitoses, would produce blood borne metastases in such a short time.

The sarcoma cells were derived from the muscle the majority of cells were spindle. Numerous giant cells also were present.

In general the growths were not vascular and little stroma could be demonstrated by ordinary methods but silver impregnation revealed an abundant reticulum which closely invested the individual cells of the sarcomatous portion.

LEE PULLEN M.D.

TRACHEA, LUNGS, AND PLEURA

Blackburn G., and D'Aren A. L.: Thoracoabdominal Wounds in War. *Br J Surg* 1945 33: 153

The authors analyze 126 cases of thoracoabdominal wounds treated at forward operating centers and 74 cases treated in the surgical division of a base hospital. Of the 126 patients treated at forward operating centers 46 (36.5%) died of the 74 patients who reached the base hospital, only 3 died.

The distinction between thoracoabdominal wounds and abdominothoracic wounds is important. The great majority of wounds belong to the first group the wound of entry is in the chest, and the foreign body or the wound of exit is below the diaphragm. The thoracoabdominal wounds respond more favorably than those of the opposite type, and are less likely to require laparotomy. Wounds of the right side tend especially to belong in this category and if the liver is the sole abdominal viscus that is injured a laparotomy need not and should not be undertaken. Only 8 of 65 right sided wounds had an associated hollow viscus lesion while 30 of 61 left sided wounds had hollow viscus lesions, with a correspondingly greater mortality among the patients with left-sided wounds. The authors believe that laparotomy should be avoided if possible. If how ever a laparotomy is necessary a Kocher's incision will give excellent access. The type of thoracic operation also is subject to variation most British surgeons being content with rib resection and closure of the pleura after repair of the thoracoabdominal injury has a place, especially for wounds on the right side, but certainty of diagnosis is difficult without radiography. A wound may be labelled thoracoabdominal only when (1) a foreign body with an entry wound in the chest, can be demonstrated below the diaphragm (2) hematuria is combined with hemothorax or hemopneumothorax (3) the presence of

INTERNATIONAL ABSTRACT OF SURGERY

pleurobiliary fistula is proved by thoracic paracentesis.

Although the mortality rate in those patients who survive the initial wounding and operative treatment is low the morbidity rate is high.

The complications in the series of 74 cases were as follows:

Hemothorax, 38 cases atelectasis, 15 cases subphrenic abscess 12 cases (6 with coincident empyema), empyema 11 cases empyema with pleurobiliary fistula 7 cases lung abscess, 3 cases and liver abscess, 2 cases.

The management of hemothorax is no different from that in a simple thoracic wound. Re-expansion of atelectatic lobes after postural drainage and breathing exercises is the rule and a course of sulfadiazine is often of value in reducing pyrexia where progress is slow. Both lung abscesses recorded in the table resolved without operation, but were treated with a course of parenteral penicillin.

The most significant complication is empyema. All cases of empyema are not due to infection of the hemothorax, since a considerable number follow a lower lobe collapse associated with serous effusions that become purulent. It is essential, therefore, to watch for signs of effusion constantly and to perform paracentesis thoracis if clinical or radiological signs develop. The diagnosis of pleurobiliary fistula is easily made by examination of fluid obtained by aspiration from the pleural cavity. Drainage should be instituted early, as loculation is likely if drainage is delayed. Significant diagnostic features of subphrenic abscess were hectic fever with its constitutional malaise, high leucocytosis, local tenderness and swelling, restricted rib movements, a diaphragm invisible radiologically with a fluid level beneath it and an overlying sympathetic pleural effusion. Diaphragmatic hernia is uncommon as a sequel of thoracoabdominal wounds.

The causative missile is rarely seen during operation for thoracoabdominal injuries but should be removed if easily accessible. In cases with retained foreign bodies, the liver is a common site, but the late of retained missiles in the liver is difficult to ascertain. It may be wishful thinking to suggest that they do not often cause mischief. A case of fatal abscess occurring in the liver after removal of a foreign body is reported.

JOHN L. LINDQUIST, M.D.

ESOPHAGUS AND MEDIASTINUM

Nielsen, J.: Clinical Results with Rotation Therapy in Cancer of the Esophagus. *Acta radiol.* Stockholm, 1945 26: 361.

Rotation therapy offers some fresh possibilities in dealing with cancer of the esophagus which has hitherto proved little amenable to curative treatment. The author's report is based on results obtained with the rotation method of treatment in the past 3 years. The clinical development of carcinoma of the esophagus (the most malignant and most

rapidly lethal form and site of epithelial cancer) has hitherto been so quickly fatal that it is permissible already after a relatively short period of observation, to draw certain conclusions with regard to the therapeutic effect.

Experimental studies and measurements on phantoms revealed that the most favorable degree of effect is obtained when the focus skin and the half size of the field and the object, and when the latter are as small as possible. With the use of 180 kilovolts 0.5 mm. of copper and 15 milliamperes, the intensity measured in air is 65 r/min. at a distance of 40 cm., and 42 r/min. at a distance of 50 cm. Each sitting can thus be given in a reasonably short period of time (10 to 15 minutes).

The material was comprised wholly of referred cases. No case was refused, not even at the preliminary examination. A considerable proportion of the patients were severely affected and much encumbered with metastases to the lymph nodes in the neck, and the liver, the lungs, and the bones.

One hundred and ninety-four patients were treated by irradiation. Of these, 174 (90%) were given rotation therapy. Eight patients (4%) were so feeble upon admission that no treatment could be given. Twelve patients (6%) in whom the cancer was situated in the cervical part of the esophagus (most of these were women), or at the level of the jugulum (a not uncommon site in men) were given crossfire irradiation to multiple fixed fields but the author believes that the rotatory treatment will always have the advantage, essentially over crossfire irradiation through fixed fields by increasing the depth dose rendering the focal dose homogeneous, and eliminating the risk of over-crossing effects.

The screening control requires that the patient shall be seated on a stool which during irradiation rotates about a vertical axis, while the roentgen tube is fixed in a position with the central ray directed horizontally. Only slight cutaneous reactions were observed, and in spite of large daily and total doses, there were no general reactions except moderate leucopenia nor were there any other unpleasant after symptoms. The total dose, which is reached in the course of 5 to 6 weeks (sometimes 7 to 8 weeks and a minimum of 3 weeks) is about 5,000 roentgens.

The roentgenological diagnosis of tumor in all the cases was verified by microscopy in 113 (60%) squamocellular carcinomas of the esophagus, which constitute the majority of the carcinomas in that site, are not as highly differentiated as for instance, carcinomas of the tongue and oral cavity and would indicate a correspondingly greater radiosensitivity. There is, therefore reason to contest the not uncommon belief that nearly all carcinomas of the esophagus are, histologically of a strongly keratinizing squamocellular type, and consequently radioresistant. When the question is of squamocellular carcinomas, which on account of their comparatively slight

SURGERY OF THE THORAX

radiosensitivity require a considerable amount of daily radiation, the reaction of the tumor will be all the greater the shorter the full treatment time can be made in other words the higher single and daily doses can be given. If the treatment is extended over too long a period there is time for the development of connective tissue reactions with the result that not all the cancer cells become destroyed.

In 117 cases (four fifths of those fully treated and two-thirds of the total number) complete or nearly complete primary freedom from symptoms was obtained that is almost normal deglutition and roentgenologically marked improvement of the esophagus. The improvement of the deglutition was of shorter or longer duration. Recurrences in the esophagus were not infrequent they often occurred above or below the primary stenosis and were then accessible to another palliative irradiation. In many cases the patient was able to swallow right up to the time of death which in most cases was due to metastases or cachexia. The results so far show an indubitable improvement of the survival curve.

LEE PULLEN M.D.

MISCELLANEOUS

Wood, H., and Sweetser H. B. Jr.: Punctate Cerebral Hemorrhage following Thoracic Trauma
U S Nav M Bull., 1946 46 57

On the authors hospital ship 3 fatalities were encountered from symmetrical diffuse, punctate cerebral hemorrhage secondary to severe thoracic trauma and multiple fractures. The first case carried a diagnosis of atmospheric blast concussion the second resulted from a fall. Histological study of the 3 cases revealed hardly any cerebral fat embolism as a basis for the punctate cerebral hemorrhages.

The first patient, injured by an atmospheric blast had an extensive right thoracic and abdominal contusion, right hemothorax, puncture of the right lung one fractured right rib a fracture of the humerus and right acetabulum rupture of the spleen and liver hematoma of the right adrenal gland, renal bleeding mediastinal hemorrhage, and hemorrhages into the serous membranes of the thoracic and abdominal cavities.

The second patient was injured by a fall from a height of 25 feet, which resulted in an extensive

right thoracic contusion fracture of 6 right ribs, right hemothorax and atelectasis (with terminal acute lobular pneumonias) puncture of the right diaphragm and the liver, and hemorrhages into the serous membranes of the pleural and abdominal cavities. Each case was characterized clinically by progressive coma with no localizing neurological signs.

Both patients showed pulmonary fat embolism. The first case in which there was fracture of the long bones was much more extensive than the second. A fat embolus was demonstrated in a capillary of the cerebral white matter in the patient cited in case 1 but it was not associated with hemorrhage. No fat embolism was demonstrated in the cerebral white matter of the patient in case 2.

The hypothesis is presented that the force of the trauma to the thorax of these patients was transmitted to the venous circulation and resulted in a retrograde wave of elevated venous pressure. The degree of force involved in these cases was sufficient to overcome the barrier of the one set of venous valves located near the termination of each internal jugular vein. From that level to the capillaries of the brain there are two direct, relatively short columns of blood which are unprotected by venous valves.

The most abrupt change in vessel caliber is from the capillaries of the cerebral white matter and the basal nuclei to the great cerebral vein. The venous tract from the capillaries of the cerebral white matter basal nuclei and upper midbrain to the confluence of the dural sinuses is more direct, and is generally shorter than the tract from the capillaries of the cerebral cortex to the confluence of the sinuses. The angles at which the superior cerebral veins enter the superior sagittal sinus and the presence of the folds of dura in relation to the ostia of these veins would tend to lend protection to the capillaries of the cortex from a retrograde wave of pressure.

In brief a retrograde wave of venous pressure should strike the capillaries and venules of the cerebral white matter before it strikes those of the cerebral cortex. The force should be less readily dispersed in the white matter than in the cortex. This hypothesis should be subjected to experimental study.

LYNN JOHNSON M.D.

SURGERY OF THE ABDOMEN

ABDOMINAL WALL AND PERITONEUM

Chandy, J.: The Use of Heterogenous Fascial Grafts in the Radical Operation for Hernias. *Ann. Surg.* 1945, 835

The author apparently prepares his own deep fascia of an ox or cow and uses white cotton No. 40 for sewing the flap of fascia to protect the floor of the inguinal canal.

The preserved ox fascia, which measures about 5 by 15 inches is dried of alcohol between gauze and placed on the area. One long border of the fascial graft is sutured to Poupart's ligament by 4 interrupted sutures. The lower corner is sutured to Cooper's ligament and the inferior border is fastened to the periosteum of the pubic bone taking care to include a good part of the periosteum. A slit about one half inch in length is made on the upper border of the graft, and the cord is passed through this opening. A suture is passed through the *fals inguinalis* while the muscle is being lifted by a retractor, continued through both corners of the slit and tied. The fascial graft is thus anchored under the *fals inguinalis* with allowance for passage of the cord. Two sutures are used to anchor the fascia under the conjoined tendon, and 3 to secure the fascia under the rectus sheath on the medial side. Sometimes it may be necessary to slit a part of the rectus sheath to insert the fascial graft under that ligament. Now the fascia is well anchored to Poupart's *fals inguinalis* and rectus sheath, and under and to the through a narrow slit in the fascia.

The cut edges of the external oblique aponeurosis are next sutured and the wound is closed by interrupted sutures.

The work of Hays on the use of preserved ox fascia in the living dog has been extended to patients. Especially prepared ox fascia appears to heal solidly in human tissue.

Experience with 158 cases, and follow up observations on a series of 53 employees of a firm providing routine medical examinations at monthly intervals, are presented. There were no recurrences in the latter group after periods of observation ranging from 10 months to 4 years and no recurrences were reported in the remaining 105 patients.

JOSEPH GARTER, M.D.

GASTROINTESTINAL TRACT

Somervell T. H. Physiological Gastrectomy. *Bull. J. Surg.* 1945, 33, 46.

The author has been replacing the extensive operation of partial gastrectomy by the more modest procedure of ligating the arterial supply of the stomach with good immediate results. The opera-

tion of vascular ligature has been done in 400 cases, 160 of which have been studied by test meals before, and 3 weeks after operation, and 82 of which have had a late follow-up including the performance of fractional test meal and a thorough clinical examination. In 380 cases of arterial ligature with or without gastroenterostomy only 1 death could be traced. The minimal operative risk and satisfactory results of the simpler operation are believed to give which the total acidity of the fasting juice is above 60, gastroenterostomy combined with ligation of the arterial supply of the stomach is carried out, except in the cases of patients with gastric ulcer as well as a duodenal ulcer or those in whom malignancy is suspected.

The operation of tying the arteries in its simplest form, consists of firmly ligating with fine silk about 5 of every 6 of the small branches which run from the gastrophlopic artery to the stomach wall as far up the greater curvature as possible without pulling at the stomach. The sheaf of vessels on the lesser curvature is ligated *in toto*. The arteries at the pylorus and within an inch of it need not be tied. The posterior wall of the stomach is then greatly pulled through the opening in the mesocolon and it is usually found that further ligations must be done to bring the number of ligated vessels up to approximately five-sixths of the total number. Gastrojejunostomy is then performed.

When the arteries are tied in this way the usual effect is an immediate and considerable drop in the acidity of the stomach. A hyperacid stomach becomes one which secretes less than the normal amount of acid. Control studies were made by testing pre- and postoperative acidities in cases of arterial ligature without gastroenterostomy and in cases of gastroenterostomy without arterial ligature. The results of these studies indicate that the reduction of acidity is due to the ligation of the arteries and not to the gastroenterostomy.

Fractional test meals were done in 82 cases from 6 months to 6 years after operation. It was found that the lowering of acidity persists for at least 3 years and the late results showed very satisfactory figures both for the acidity of the fasting juice and for the average total acidity during the 3 hours or so after the meal was given. In cases in which the operation of arterial ligature alone was done, without gastroenterostomy, the early and late results were exactly similar to those in which arterial ligature and gastroenterostomy were combined. With regard to the incidence of recurrent (gastrojejunal) ulcer of the total number of 400 patients in whom this operation has been done, only 2 has returned to the hospital with a gastrojejunal ulcer. This is in contrast to the incidence of 7 cases of recurrent ulcer in a series of 300 cases in which a gastrectomy

had been done during the same period. It is believed that arterial ligation is the operation of choice in all cases of duodenal ulcer with marked hyperacidity.

JOHN L. LONGQUEST M.D.

Oleson, O.: Multiple Cancer of the Colon (Cancer collimultiplex). *Acta radiol. Stockh.* 1945 26 415

The paucity of clinically diagnosed multiple carcinomas of the colon as compared with the figures from the autopsy room suggests of course that many cases of multiple cancer of this region are not being diagnosed. This is of interest to the roentgenologist, who must not rest content with having established the diagnosis of a cancer of the large bowel but should continue his examination to include the entire colon. Even though the referring surgeon be satisfied with the digital or proctoscopic findings of carcinoma of the rectum, in view of the especial frequency of the combination of rectal cancer with a second cancer in another section of the colon (this combination being found in perhaps a half of all the cases of multiple tumors of the large gut), a complete examination of the entire colon should be made since the tumor which is overlooked in these cases may eventuate seriously.

The surgeon who refers his patient to the roentgenologist frequently merely wants the determination of the upper limits of the tumor which he already knows to be present or he wants to know the length of the sigmoid for the technical operative value of such determination. He may even oppose the filling of the entire bowel with the shadow producing medium. The roentgenologist, however, should not limit his quest for considerations such as these. Of course, the entire colon should not be burdened with the medium when an acute ileus is present, or in the presence of an almost impervious stenosis of the bowel lumen. However in the latter case too much importance should not be attached to the fact that the inflowing of the contrast material in retrograde direction is difficult.

In making the decision to break off the examination short of the entire length of the colon the preliminary roentgenogram without contrast substance should be carefully studied particularly in the presence of acute ileus or when there has been a history of attacks of acute or subacute ileus in order to estimate if the succeeding contrast roentgenogram sufficiently explains the history symptoms and present findings. If then for any reason the examination remains a partial one the surgeon should of course be apprised of the fact that the examination is incomplete. According to Crawford (*Acta chir scand.* 1934, 74) not less than 65 per cent of his 161 patients with an obstruction presented stenoses.

The author appends 5 case histories of multiple cancer of the colon—the rectum and anal sections are included as part of the colon—from a year's material of from 50 to 60 cancers of the colon and from 700 to 800 examinations. In only 1 of these did the roentgenologist fail to uncover the multiplicity of the condition.

JOHN W. BRENNAN M.D.

Jenkins, J. A.: Carcinoma of the Rectum, with Special Reference to Sphincteric Control. *Austral. N. Zealand J. Surg.* 1945 15 15

Radical operation for carcinoma of the rectum must continue to be the method of choice in the majority of cases for which surgery is employed. A brief description of the procedure adopted in cases in which the sphincteric mechanism can not be saved is presented. The author prefers a two stage operation.

The first stage involves exploration through a left oblique abdominal incision to determine the extent of the growth and fixity. If conservative preservation of the sphincters is decided upon a transverse defunctioning colostomy is done. If a radical perineoabdominal excision of the rectum is not contraindicated a terminal colostomy is performed. The pelvic colon is exteriorized and divided the proximal stump, held by forceps, is retained in the upper angle of the wound and the lateral peritoneal passage is closed by suture the distal stump is closed and intussuscepted into itself as far as possible and placed in the pelvis. The abdomen is then closed.

The second stage is carried out about 3 weeks after the first stage. The perineal part of the operation is done first and completed abdominally. A vaseline gauze pack is introduced into the pelvic cavity and commencing about the tenth day is gradually removed. A catheter and tidal drainage prevent the threatening bladder infection.

The author presents case histories and reports his observations with regard to the various conservative surgical procedures attempted, in which the sphincteric mechanism is retained. He cites the literature dealing with various conservative procedures and the indications for their adoption in selected cases. Pathologically various reports have modified the earlier hypothesis of the manner of spread of carcinoma of the rectum based on the work of Miles. For example, Pannett states that the rectum can be safely incised 15 cm. below the tumor and 25 cm. above. Functional results are mentioned by most writers and all appear to be reasonably satisfied with the control achieved. However Kirschner states that even after perfect healing complete continence is rarely achieved because of unavoidable damage to the sphincter and to the nerves of the sacral plexus supplying it.

The author suggests a preliminary defunctioning transverse colostomy when conservative procedures are to be followed. A wider sacral exposure with consequent avoidance of splitting the posterior vaginal wall is suggested. The anorectal sphincteric ring is retained intact, as far as musculature is concerned to avoid loss of function. The author believes that after resection of the rectum the patient must depend upon external sphincters for control, and that this control is inadequate when compared to the normal mechanism. No reference could be found in the literature as to the state of the internal sphincter muscle after operation however it is sup-

posed that the intrinsic nerve supply must be abolished. The normal reflex changes which influence the tone of the internal sphincter become inoperative thereby a loss of defecation reflexes occur. There is no doubt that the involuntary non-striated internal sphincter is important in the control of the anal sphincteric mechanism and that it possesses a continuous postural tone that varies slowly in response to reflexes from the bowel above. Although the condition of the internal sphincter has not been established after resection of the rectum, it has been thought that its tone was dependent upon the integrity of a local nerve plexus and therefore, theoretically it is possible of recovery following injury.

Since the external sphincter plays an important part in voluntary and reflex responses to effort and in temporary control its retention with its nerve supply is advisable. Impulses from the pelvic colon may give the patient warning of imminent action of the bowels and this action may be temporarily restrained by voluntary contraction of the sphincter and externus.

The Hochenberg pull-through operation gives the most satisfactory results in conservative surgery of the rectum in which the sphincteric mechanism is preserved.

JOHN E. KARASH, M.D.

LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

Robertson, H. E., and Ferguson, W. J. The Diverticula (Luschka's Crypts) of the Gall Bladder. *Arch. Path., Chic.*, 1945 43: 2.

The peculiar outpouchings of the mucosa of the gall bladder known as Luschka's crypts, have been so frequently described that there would appear to be nothing important that could be added to the knowledge of their morphology, pathogenesis, or complications. However a closer study reveals so many misconceptions concerning them that an attempt to clarify their anatomic and pathological significance is fully justified.

The gall bladders studied were from two sources: 175 from postmortem examinations and 320 from surgical operations. The authors' special endeavor was to identify crypts in various normal and pathological gall bladders. Examinations were made of a sufficient portion from each specimen to afford a fairly accurate picture of the relative number and depth of the crypts that were actually present.

Among the 175 gall bladders from postmortem examinations, 112 were judged to be grossly and microscopically normal. The term "normal" is used to imply the absence of identifiable signs of any pathological condition that could influence the functions of the gall bladder materially or could contribute clinical phenomena of disease. Of the 112 gall bladders, 65 (58 per cent) apparently contained no diverticula. Thirty-eight of the remaining 47 normal gall bladders revealed diverticula, grade 1 and only 9 could be graded 2 or 3. The conclusion

appears justifiable that anatomically normal gall bladders contain few diverticula and they tend to remain superficially located.

The 320 gall bladders that were removed by surgical operation were from patients who presumably had definite signs or symptoms of gall bladder disease. At any rate the proportion of those gall bladders that contained no diverticula was distinctly less than that of normal gall bladders removed at postmortem examination.

The extensive review of the data furnished by the work of others and of the results of the authors' investigations gives a perspective which appears to represent a logical solution of the several problems with which the literature has been engaged for the past 100 years or more.

The following conclusions were drawn:

1. In approximately half of all gall bladders removed from persons of more than 30 years of age the mucosa has invaginated the underlying structures, sometimes as far as the peritoneal lining.

2. This invagination tends to form diverticular spaces with branching pouches which occasionally simulate mucous glands. They are lined with epithelium corresponding in every respect to that which lines the mucosa of the inner surface of the gall bladder. These cells secrete mucus or a mucouslike fluid.

3. The greater number of the diverticula open into the gall bladder lumen by ducts, which are often tortuous and narrow. Some are cut off in whole or in part from the lumen and become cysts with budlike branches. When such a group is more or less localized, a formation, often called an adenoma, is produced. This is most frequently found in the folds of the gall bladder but may occasionally involve more, or even all of the gall bladder wall. The term adenoma is misleading and inapplicable.

Multicystic or multilocular cystic diverticula are more fitting designations.

4. The crypts thus formed may contain bile, bile pigments, cholesterol crystals or at times, typical biliary calculi. Exudative inflammation may occur in them up to the stage of abscess formation and even of rupture into the peritoneal cavity. The mechanism of such inflammation may be obliteration of the epithelial lining, proliferation of connective tissue and collections of lymphocytes and other cells.

5. Increased intracystic pressure, absence of a muscularis mucosae, a loosely irregularly arranged muscular layer and the independent response of the muscle bundles to physiological stimuli account for the initial diverticularlike indentations. The increased pressure is, more logically, the result of neurogenic dysfunctional states of the extrabiliary biliary system although other mechanical factors such as stones and inflammatory obstructions may play etiological roles.

6. Except for the complexity of the branches, these crypts correspond in every other respect to the so-called false diverticula of the colon and urinary bladder: they are "diverticula of the gall bladder."

7 There is little justification except custom, for calling them Luschka's crypts or Rokitsansky Aschoff sinuses. Not only did these investigators not possess sufficient priority but they failed in several important details to recognize the true significance of the structures that they described.

Maacheroni H. A., Roussi, C. and Boucau E. F.: Internal Biliary Fistulas (Las fistulas biliares internas) *Presna med argen* 1945 38 1397

Internal biliary fistulas may communicate with a pregnant uterus, ovarian cysts, the pericardium, urethra, or the pleural cavity. However in the majority of cases the fistula communicates with the duodenum, stomach, colon, or small intestine. According to one set of statistics 67 internal biliary fistulas were found among 30,000 autopsies. Puestow encountered internal fistulas in 1.2 per cent of his patients with cholecystitis.

The main cause of internal fistula is cholelithiasis or a cancer of the gall bladder. Less frequent causes are abscess of the gall bladder and echinococcus cysts. As to the pathogenesis, pressure by a calculus causes an ulceration of the mucosa, which leads to perivescitis and the formation of adhesions, necrosis, and, ultimately, a fistula. Periduodenitis as a sequel of duodenal ulcer may also lead to the establishment of a communication between the gall bladder and duodenum either directly or through a fistula resulting from an abscess between both organs. A cancer of the gall bladder may invade the adjacent tissues and form fistulas leading to the colon in a great number of cases.

No pathognomonic signs are characteristic of an acute internal biliary fistula. Puestow states that suspicion of an internal fistula is justified in patients with a hepatic colic accompanied by chills, fever, and jaundice, especially if such symptoms are frequent, persistent, or progressive.

In chronic forms dyspepsia may be the only symptom with nausea, vomiting, and pains following errors in the diet.

Röntgenological studies are of great diagnostic value. The opaque medium may be introduced through a duodenal tube. X-ray pictures should be taken in various positions such as the supine, prone, right lateral, and Trendelenburg. The presence of gas in the biliary ducts is a rarity, but, if detected, it points to the existence of an internal fistula of the bile tract.

Involvement of the liver is a grave complication found most frequently in fistulas leading to the colon. Inasmuch as the prognosis of an internal biliary fistula is always grave, surgical intervention should not be delayed although the operative mortality is relatively high, reaching 70 per cent. Especially in acute forms a delay makes the prognosis poor. The fact that bile may be aspirated through a duodenal tube is of no diagnostic value and does not suggest any special time for the surgical intervention.

Persistent jaundice and the presence of white bile in the duodenal contents indicates hepatitis.

The author reports 3 cases of internal biliary fistula.

JOSEPH K. NARAT, M.D.

Itolz, O. A.: Tumors of the Pancreas (Tumores de pancreas) *Arch Soc argen anal*, 1944, 6 451

The author offers the following classification of tumors of the pancreas:

A. Primary tumors: (1) benign unilocular or multilocular cyst, cystadenoma, solid tumor, insular adenoma, angiomatous tumor, and ampullary tumor; (2) malignant: epithelioma of the head of the pancreas, epithelioma of the body or the tail of the pancreas, cystadenoma, carcinoma, malignant insular tumor, malignant ampullary tumor, and sarcoma of the pancreas.

B. Metastatic tumors with primary neoplasm located in the stomach, spleen, left kidney, small intestine, or lymph glands.

Adenoma and malignant insular tumor produce identical symptoms.

Cystadenoma and cystadenocarcinoma have the same macroscopic aspect and only the histological examination will lead to the correct diagnosis. The differentiation of ampullary tumors of the pancreas and neoplasms originating in the lower portion of the common duct offers great difficulties.

If hydatidiform cysts, pseudocysts, and dermoids are excluded, pancreatic cysts may be divided into two groups: congenital and retention cysts.

Cancer of the pancreas forms from 1 to 2 per cent of all cancers found at autopsies. Metastases appear in relatively early stages and are found in three groups of lymph glands: subpyloric, mesenteric, and splenic. A fourth group of minor importance is found behind the pancreatic glands.

From the histological point of view, 4 types of cancer of the pancreas may be distinguished: papillary cystic carcinoma, adenocarcinoma, the medullary type, and epithelioma formed by independent cells disseminated throughout the abundant stroma. The last two mentioned forms probably derive from acini.

Sarcoma of the pancreas is extremely rare.

JOSEPH K. NARAT, M.D.

Radlke, J. C., and Rivero, E.: Statistical Studies of 53 Cases of Tumors of the Pancreas (Estudio estadístico sobre tumores y tres casos de tumores de pancreas) *Arch. Soc argen anal*, 1944, 6 489

Of 53 tumors of the pancreas observed by the authors, 49 were primary and 4, secondary formations. 39 were found in men and 15 in women. Two-thirds of the tumors were found in patients between 50 and 60 years of age. The great majority of the patients were laborers. The largest number of tumors were located in the head of the pancreas, to be followed by that of neoplasms in the tail and the body. Married people predominated in the material observed by the authors.

In numerous instances the diagnostic difficulties were great and cancer of the liver, tuberculosis, blood cysts of the pancreas, tumors of the mesocolon

and cancer of the biliary tract were considered. Among clinical symptoms pain occupied the main place. Jaundice, colic of the hepatic type, a sensation of fullness, nausea, biliary vomiting, icterus, and hematemesis were less frequently observed.

Among complications the following were recorded: obstruction of the biliary ducts, ascites, liver cirrhosis, fat necrosis, brown atrophy of the myocardium and pneumonia.

The most frequent type of tumors was cancer. The malignant degeneration was accompanied by 3 histological changes: fibrosis, acidophilic necrosis, and flattening of the acini. The authors confirm the observation made by other writers that glandular acini undergo rapid destruction by the cancerous tissue while the Langerhans islets show attempts at regeneration. In 4 cases an association of the cancer of the pancreas with diabetes was observed. In 1 case the cancer was located in the head of the pancreas, in the second in the tail, in the third both in the body and the tail, and in the fourth the entire organ was invaded.

The most frequent location of metastases was the liver, to be followed in descending order of frequency by the lungs, lymph glands and peritoneum. The largest tumor was the size of a newborn child's head.

Metastatic tumors were found nearly exclusively in the male sex, mostly in the sixth decade of life, with the location of the primary tumors in the gall bladder, biliary ducts, esophagus, and lungs.

JOSEPH K. NARAT, M.D.

Ceballos, A., Brachetto, Brian D., and Rosenblatt, B. Insular Adenoma of the Pancreas. The First Case in Argentina. (Adenoma insular de pancreas. Primer caso Argentino) *Arch. Soc. argent. med.* 9:44, 6 309

A woman, age 37, had been complaining for 4 years of attacks of nervousness, profuse perspiration, and tremor during the preprandial periods which disappeared after the ingestion of food. Hypoglycemia, accompanied by general debility, tremor, perspiration, mental confusion, found at the clinical examination could be relieved by the ingestion of carbohydrates or an intravenous injection of glucose solution. The differential diagnosis involved a spontaneous hypoglycemia or paroxysmal manifestation of some other condition. No signs of an involvement of the liver, hypophysis, thyroid gland, suprarenal glands, or the central nervous system could be found. Therefore, an adenoma of the Langerhans islets was suspected.

An exploratory laparotomy revealed an adenomatous nodule situated at the junction of the head and the body of the pancreas. The tumor had an ovoid shape 13 by 6 mm. in diameter. It weighed 155 gm. and was encapsulated. The parenchyma of the tumor had a whitish color and an adenomatous aspect. The tumor was divided by fibrous bands into alveoli. The microscopic examination disclosed two types of cells: () high cylindrical cells with a clear cytoplasm and irregular ovoid nuclei, and ()

low cuboid or pyramidal cells with a chromophilic protoplasm and pyknotic nuclei. The latter type of cells was in the minority. JOSEPH K. NARAT, M.D.

Bianchi, A. E.: Pancreatic Insular Carcinoma (Neuroblastoma) with Generalized Metastases (Carcinoma insular pancreatis [neuroblastoma] con metastasis generalizadas) *Arch. Soc. argent. med.* 9:44, 6 497

Since the publication of the first case of insular adenocarcinoma in 1927 numerous articles have described benign as well as malignant tumors originating in Langerhans islets. In 1938 Laidlaw suggested the term "neuroblastoma" for tumors originating in the islets and the term "neuroblastoma" for hyperplastic reactive changes of a non-neoplastic nature.

The author of this article collected from the literature 120 cases of benign tumor involving the pancreatic islets.

He observed such a tumor in a woman, age 39, who was admitted to the hospital with complaints of intensive premenstrual pains in the left axillary region, occasionally radiating to the right shoulder. The complaints were of one year's duration. The patient also had pains in the lumbar region radiating into the lower extremities. At the time of admission numerous white or bluish nodules were found scattered throughout the body. A bloody expectoration of 3 days' duration was present.

Among the important findings the following may be mentioned: the blood sugar was 117, albumin, sugar, and acetone were found in the urine, the Kahn reaction was negative and the blood count and differential count were normal. Examination of the contents aspirated from one of the nodules revealed nondifferentiated neoplastic cells. Aspiration of the liver was done and the microscopic examination showed large cells with round nuclei and polygonal protoplasm. These cells resembled those found in the cutaneous nodules. The identification of the neoplastic cells was very difficult. Atypical mitoses were noticed. A blood examination 2 weeks after admission showed the presence of myelocytes, metamyelocytes, and normoblasts.

The febrile condition led to a fatal outcome. The autopsy revealed cystohemorrhagic formations in the liver, nephrosis, hemorrhagic ovarian cysts, hemoperitoneum and hydrothorax on the right side. A circumscribed mass was found in the pancreas which showed a diffuse enlargement.

The histological examination disclosed a generalized endothelioma, partially solid and partially with the characteristics of a hemorrhagic angioendotheliomatosis. Various staining methods, such as Mallory's and Van Gieson's, and thionine, allowed a diagnosis of a neuroblastoma originating in the Langerhans islets. The author calls attention to the fact that the blood sugar level remained normal and that numerous metastases spread through the blood as well as the lymph system.

JOSEPH K. NARAT, M.D.

MISCELLANEOUS

Etherington-Wilson W. Torsion of the Great Omentum. *Brit J Surg* 1945 33 143

A review of the literature on torsion of the great omentum yields some 190 cases of all varieties, of which 75 can be considered of the primary or idiopathic type. The author reports 4 cases, of which 1 was primary 2 were bipolar with a pelvic adhesion, and 1 was swollen and infected by tubercle bacilli. The 4 pathological specimens are illustrated.

The great omentum may twist as a whole or as a part or strand either may be complete (strangulated) or incomplete (congested) either may be primary or secondary. Primary twists are necessarily intra-abdominal and unipolar and no definite cause can be ascertained. In cases of secondary rotation, the condition may be unipolar or bipolar, and occur as a result of hernia adhesion, omental deformity or past or present intraperitoneal inflammation. The condition may be acute subacute or recurrent. A combination of factors is probably responsible for the causation of omental torsion, such as Peristaltic pushes by the muscle of the intestines abdominal wall, and diaphragm sudden jerky body actions and rotations direct blows omental disfigurement by tumors overloading or uneven fat distribution pedicle formation scarring ruggedness adhesions and bipolar attachments displacement of the omentum during operation or by abdominal tumors. A history of all such causes is found among the cases recorded. A partial twist having started and caused congestion of the veins with edema, it has been suggested that the shorter and firmer arteries may complete the omental twisting. Males are more often affected than females, which may be accounted for by trauma or exertion. The condition is uncommon at the extremes of age.

The condition is rarely diagnosed or even suspected. Over 80 per cent of cases are diagnosed as appendicitis, and a much smaller number as perforated ulcers or cholecystitis. The following points are worthy of notice and should lead to the correct diagnosis on occasion. The patient probably from 20 to 55 years of age, and a male gives a history of right-sided abdominal pain which gradually gets worse, is often in spasms and is usually relieved by lying down. Other symptoms and signs are not pronounced and are of little differential value. Tenderness and rigidity are not impressive. There may be a history of undue exertion or accident, and a hernial scar or sac may be present. The palpation of a doughy tumor in the midline or to the right, often above the appendix is a suggestive sign.

The treatment consists of early exploration. The omentum, or a part, is almost always removed. Occasionally as in one of the cases reported here the strangulated omentum is simply untwisted. Apart from complications which are remote, few patients have succumbed to the abdominal condition.

JOHN L. LINCOLN M.D.

Eaton, R. B.: Forward Abdominal Surgery. *Canad M Ass J* 1946 54 19.

The author relates his personal experiences and observations, and the lessons learned during the surgical treatment of 230 patients in a Forward Surgical Unit at an advanced Surgical Center with the R.C.A.M.C. The experience began in Normandy and ended in Northwest Germany and Holland. Twenty-one of the patients had acute abdominal lesions all others presented battle casualties of first or second priority. There were 38 deaths.

The time interval from injury to operation the distance and the extent and site of the injuries are stressed as the most important factors in the outcome of the cases. In abdominal cases the optimum time was from 6 to 8 hours and the distance from 10 to 15 miles. The optimum time for operation after resuscitation had begun was left to the judgment of the resuscitation officers who became exceedingly skilled in their ability to determine the correct moment for surgical intervention. Pulse volume and the restoration of peripheral circulation were considered the best guides to the optimum time for surgery. Blood pressure was considered of less importance as it was often difficult to get the blood pressure above 80 to 90 mm Hg thus a stable blood pressure plateau was of more importance than the height of a single reading. If the optimum time for surgery was missed secondary resuscitation was usually impossible and a state of irreversible shock was likely. However, no abdominal case was considered hopeless until a laparotomy had been performed even though the response to resuscitation was not good.

The diagnosis was usually obvious and clear cut. It consisted mainly of determining the general condition of the patient, and the number and course of his wounds. Audible peristalsis usually ruled out an intraperitoneal lesion, but flank wounds with lacerated colons were exceptions. Chest wounds produced transient abdominal signs which were confusing but which disappeared with rest and resuscitation. Exploratory laparotomy was resorted to when there was doubt as to the existence of intra-abdominal wounds.

Routine exploratory laparotomy incisions were used in most cases but occasionally transverse incisions from the outer border of the erector spinae to the rectus muscle were used. They gave excellent exposure for flank wounds with kidney involvement, and made it possible to deal with the kidney first and then open the peritoneum to explore the peritoneal cavity. Abdominal laparotomy wounds were occasionally carried through the costal margin, which was reflected to give good exposure of the diaphragm liver and cardia.

The rule for the management of large bowel wounds was mobilization and exteriorization. Multiple wounds of the cecum and ascending colon required exteriorization, while less extensive ones could be sutured, and in both cases a short-circuiting Rhotransverse colostomy was done. Occasionally

wounds of the cecum and ascending colon were simply sutured and a drain inserted to the area. Spurs were feasible with left colon colostomies but gave difficulty and if used should not be over 2 inches long. Multiple wounds of the colon, and pelvicolon wounds were sutured distal to a safety colostomy. Drainage was done in all cases of large bowel contamination.

Small bowel wounds were preferably sutured. Resection was necessary for multiple wounds and for wounds involving the mesentery. A single long resection was preferred to multiple short ones. End-to-end anastomosis was preferred, with a double-layer running suture and a few interrupted reinforcing sutures.

Wounds of the spleen were always treated by splenectomy. Wounds of the stomach were closed primarily with care to watch for posterior wounds when an anterior one was found. Wounds of the pancreas carried a high mortality and were treated by suture and drainage.

Lacerations of the liver were handled by deep sutures and occasionally were reinforced by omentum, but packs were avoided. Drainage to the site of injury was considered essential.

Bladders were closed in two layers with a cystostomy, care being taken to place the suprapubic tube high in the fundus of the bladder.

Spilled intestinal contents and blood in the peritoneal cavity were carefully sucked out at the beginning of the operation. Abdominal wounds were closed in layers: interrupted chromic catgut (No. 2 or 3) sutures were used except in the peritoneum. Sulfadiazine was used in the peritoneal cavity but its value was questionable. Sulfathiazole-penicillin powder was dusted into the wounds before closure of the skin.

The patients were kept from 10 to 12 days, and postoperative care was meticulous with adequate blood, plasma, and fluids. Penicillin (100,000 units per 24 hours) was used routinely and sulfa drugs were used when indicated.

Complications were few. Evisceration occurred in only 2 cases. Peritonitis, as it is known in civilian practice, was rare and only 1 patient was thought to have died of general peritonitis (not proven by post-mortem examination). There was not a single instance of fecal fistula in this series of cases. Other complications were those usually found in extensive abdominal surgery. FREDERICK C. HOSKIN, M.D.

GYNECOLOGY

UTERUS

Masclottura, E. and Baldi E. M.: Acute Torsion of the Fibroid Uterus (Volvulo de utero fibromatoso o torsion aguda de ntero fibromatoso) *Rev med chir pat fem* B Air 1945 23 512.

Two cases of acute torsion of a fibroid uterus seen during 6 years on an active gynecological service are reported. The patients presented themselves with signs and symptoms of an acute gynecological abdomen, having had trouble for 6 months and 2 or more years, respectively. There were severe intermittent abdominal pain fever and tachycardia but no signs of direct peritoneal involvement. A lower abdominal mass was palpable which produced pain on motion. Pelvic examination confirmed the presence of a nodular mass in the pelvis which prevented definite palpation of the uterus. A diagnostic sign of importance is considered to be the detection of the pulse in the uterine artery anteriorly.

Both cases were considered to be torsions of the uterine body on the cervix around the long axis of the organ. These torsions were partial as the cervix was spared in the process and incomplete because the rotation was less than 360 degrees. (The authors suggest volvulus as the diagnostic term when the cervix is not included and axial rotation when both body and cervix are implicated.) This displacement explains the anteriorly palpable pulse of the uterine artery.

Both patients were subjected to subtotal hysterectomy and made uneventful recovery.

HIRAM T. LAWORSTON M.D.

ADNEAL AND PERIUTERINE CONDITIONS

Gullner A. The Relation of the Theca Cells to Disturbances of the Menstrual Cycle *J Obst Gyn Brit Empire* 1945 52 545

The author introduces this article with a review of a previous study on the relationship between theca cells surrounding the ovarian follicles and disturbances in the menstrual cycle of the baboon. He believes that in the human being many menstrual upsets have been attributed to the presence of atretic or cystic follicles, while consideration of the accompanying masses of theca cells has been neglected.

The material from which his conclusions have been drawn for this discussion was collected from ovaries and uteri obtained at operation upon women who had complained of excessive uterine bleeding or other symptoms of endocrine disorder. There is no tabulation of the cases but a running discussion is given in which the development and changes in the theca cells are described for the primordial follicle corpus luteum atretic follicle luteal cyst, and the corpora albicantia.

The author describes luteinization of the theca cells around atretic follicles in ovaries with a co-existing corpus luteum, and differentiates between the luteinized theca and granulosa cells by the presence of blood vessels in and about the cells of the theca. Such vessels were not found to permeate the granulosa cells, although in corpora lutea the vessels extended between the lobules of the cells, but not among the cells themselves. He noted an intense vascular response with capillary hemorrhage into the interstices of the theca cells as a frequently associated finding in diffuse theca luteinization.

Theca cell luteinization around atretic follicles may be without clinical significance in ovulatory cycles. The formation of extensive areas of lutein theca cells may be visible macroscopically around the follicles but in other instances the association with the follicle may not be readily apparent. The most frequent type of change noted was one in which the cells were found to be similar to those seen as the paraluteal cells of an approximately 30 day old corpus luteum. Similarity to the cells of the adrenal cortex was emphasized.

The author states that the character of the uterine reactions associated with theca cells is such that neither estrogenic nor progestational influences can be attributed to them. Their activity suggests to him a third ovarian hormone which may exert androgenic activity or a modified secretion of the known varieties which is capable of distorting the balance between simultaneously acting steroid hormones of the menstrual cycle. GEORGE BRADBURN M.D.

EXTERNAL OENITIALIA

Novak, E. and Stevenson, R. R.: Sweet Gland Tumors of the Vulva, Benign (Hidradenoma) and Malignant (Adenocarcinoma) *Am J Obst.*, 1945 50 642

The most common location of sweat gland tumor of the vulva is on the labia majora and the next most common is in the perineal skin or perineum. The gross appearance of the lesion varies. It is always small rarely reaching a size larger than that of a cherry and usually not over 1 cm. in diameter. It may present as a small firm subcutaneous nodule like a small skin fibroma, covered by intact skin. In other cases it is soft, resembling a small sebaceous cyst, for which it is commonly mistaken. Not infrequently there is a small superficial granular area on the surface. If pressure is made on the small nodule, one is apt to be surprised by the fact that, instead of a typical sebaceous exudate the material expressed is reddish brown and pulpy. This should at once suggest the real nature of the lesion. There is no pain and often no tenderness or soreness especially when the skin surface is intact, and the nodule is ordinarily quite movable. In a consider

able number of cases the patient herself has not noticed the nodule, its removal being incidental to vaginal operative procedures.

The sweat gland tumors of the vulva constitute a relatively rare but highly interesting group. Clinically they present as small and innocent looking growths on or near the vulva, but to one not familiar with their histological appearance the microscopic picture is apt to be rather startling and perhaps lead to the diagnosis of adenocarcinoma. However in only 1 case in the literature that of Elchenberg was there apparently unquestionable evidence of malignant change, both clinical and microscopic. All other cases, including the 15 cases reported herewith, were clinically benign and all have been cured by simple excision.

Granted that the characteristic microscopic picture of these growths might well in other tissues lead to the diagnosis of adenocarcinoma, there would seem to be no justification for applying the term adenocarcinoma to these notoriously benign sweat gland tumors. It is entirely possible, and perhaps even probable that some instances of the rare primary adenocarcinoma of the vulva may be of sweat gland origin, as in 2 cases of the group included in this article. Such an origin however is difficult to establish.

Fifteen cases in white women are reported, the youngest being 28 years and the oldest 67

EDWARD L. CORNELL, M.D.

MISCELLANEOUS

Aguilera de Alvarez, M. D.: Action of the Synthetic Estrogens on the Metabolism of the Lipids (Acción d los estrogenos sintéticos sobre el metabolismo d los lípidos) *Arch. farm. biolém., Tucumán*, 1945: 33

This study concerns the relationship between the estrogenic hormones and the metabolism of the lipids in the mammal, and compares the results of the author with those obtained by other authors in the viviparous vertebrates. The synthetic hormones were used exclusively since they are the easiest to obtain and their results are, in general, similar to those of the natural hormones. By the lipids the author means that heterogeneous group of substances characterized by their insolubility in water and solubility in the so-called fat solvents such as ether, chloroform, boiling alcohol, petroleum and ether. The tissues of the experimental animals used (castrated and normal rats) were extracted with alcohol and ether according to a slightly modified method of Bloor. Total phospholipids were extracted and determined according to Folke and Subbarow with the photometer of Pulfrich. The choline fraction of the phospholipids was then determined by the technique of Marend and Cardini (*J. Biol. Chem.* 1943, pp 363-371) also the values for sphingomyelin. Finally the values for cephalin were calculated by subtracting those of the choline phospholipids from the total phospholipids, and the lecithin was

calculated by subtracting the values for sphingomyelin from the choline phospholipids. The author's determinations are given in extensive tables in the original article, and in every instance compared as a norm with the figures given by the aforesaid work of Marend and Cardini.

In all the organs of the noncastrated animals injected with stilbestrol propionate there was a relatively marked decrease in total phospholipids, with no change in the plasma values. The lecithin showed an increase in the brain and kidney and a decrease in the heart and lung without appreciable change in the spleen and liver; the cephalin exhibited an appreciable increase in the heart and blood plasma, but otherwise had decreased more than 90 per cent. In the normal animals injected with propionate of stilbestrol the sphingomyelin displayed an enormous decrease to mere vestiges in some organs or even to complete disappearance.

In the castrated animals the movement of the values in every instance tended to follow those exhibited by the normal animals except that the changes tended not to be so pronounced.

When the values for the cited lipid fractions are compared with the values for total phospholipids instead of with the normal values established for noninjected animals by Marend and Cardini, it is seen that in normal, that is, noncastrated, animals with injections of stilbestrol, the lecithin shows a tendency to increase, while in the castrated animals, it has a tendency to decrease, the cephalin following the inverse course. Although the sphingomyelin decreases in the castrated animals, it does so in a lesser degree than in the normal animals. Castration seems to inhibit in part the effects of the stilbestrol on the phospholipids of the tissues.

JOHN W. BRIDGMAN, M.D.

Schaob I. C. and Davis, J. E.: The Significance of Streptococci Isolated from the Female Urinary Tract. *Bull. Johns H. Philip Hosp.* 1945: 77-772

A review of previous reports in the literature clearly shows that with the exception of alpha and gamma enterococci (often grouped as streptococcus fecalis) the relation of streptococci to infection of the urinary tract has received little attention. The present authors have determined the incidence of streptococci in a series of 9,053 consecutive cultures from catheterized urine specimens of obstetric and gynecologic patients.

The organisms were isolated and identified by accepted procedures, and classified as follows: alpha streptococci, beta streptococci, gamma streptococci, alpha and beta enterococci (streptococcus fecalis) and microaerophilic streptococci. The beta streptococci were further classified into serological groups A, B, C, and D, and "streptococcus" group not determined. This last group included organisms that had failed to react with antisera of the other four groups. It is the group A beta streptococci which are highly pathogenic for man, the cause of the acute and severe streptococcus infec-

tions, and the most frequently isolated from clinical material

In the authors series streptococci occurred in 159 cultures, an incidence of 11.8 per cent of the total number of cultures. Of the total number of streptococci 54 per cent were alpha and gamma enterococci 49 per cent were alpha streptococci 12 per cent were beta streptococci and the small remainder were divided among the other categories. Organisms of the highly pathogenic group A beta streptococci were found in only 3 cases in the entire series. The relative incidence of these organisms judging by their incidence in other clinical material is the reverse of what might be expected. Therefore, the case histories of 500 gynecologic patients from whom these organisms had been isolated were studied in order to determine the pathogenicity of the various streptococci in the female urinary tract.

Streptococci were found to be the sole cause of clinical disease in 35.2 per cent of the cases reviewed and were found to be involved with other organisms in 38.8 per cent. They were regarded as etiologically significant in 54 per cent of the cases.

The relative occurrence of the various streptococci with *Escherichia coli* was studied and it was determined that the alpha and gamma enterococci were involved with *Escherichia coli* in a significantly higher percentage of cases than the other streptococci with the exception of the gamma streptococci.

In 40 per cent of the patients from whose urine streptococci were isolated, no clinical evidence of urinary tract disease could be found in the history. The authors suggest the possibility in these cases that the streptococci may have been the cause of a past disease or may be responsible for future exacerbations of urinary symptoms.

L. JAMES TALBOT M.D.

Stoltz, H.: Malignant Tumors of the Female Genital System (Tumores malignos do aparelho genital feminino). *An. brasil gin., 1945* 20 327

A review of the cases of malignancy of the female generative tract seen over the 10 year period from

1935 to 1945 and an account of the improvement of the facilities for conducting such work at the Clínica Ginecológica da Faculdade Nacional de Medicina of the University of Brasil in Rio de Janeiro are presented. The results are in accord with the general figures with regard to the location of the neoplasm, age and race incidence as well as the histopathological types and relation to the births.

On the basis of severity these cases are classified into four groups according to the League of Nations standards. Of the cases of cancer of the cervix (224 cases) 7.3 per cent were early cases and only 33.9 per cent were in groups I and II combined.

The most frequent organ involved was the uterus. Among the 277 cases (29 recurrent lesions) including lesions of the bladder, sigmoid colon, rectum, mesentery, breast, and uterus lesions of the uterus accounted for 134 of them, 220 being in the cervix, 4 in the cervical canal and 10 in the body.

The treatment given is determined by the degree of invasion, the histological type, and the presence and extent of secondary infection. Surgery, radium and roentgen therapy are used in various combinations. Some details of the irradiation technique are given.

Much improvement in diagnostic and therapeutic methods has occurred. For the first five year period the results may be given as follows: of 114 patients treated, 16 died during treatment and 31 were given only palliative therapy. Of the remaining 67, 10 or 14.9 per cent presented clinical cures after a period of 5 years.

The local socioeconomic factors influencing admission for early diagnosis as well as the end results are discussed. Numerous detailed tables are presented showing the frequency of location of the lesions by organs, percentage distribution by degree of invasiveness in cervical lesions, frequency of the histopathological types in all organs, the age, color and parity factors, concomitant disease, incidence of the family history of neoplasia, previous surgical operations and the frequency of various therapeutic methods which were applied.

HIRAM T. LANGSTON M.D.

OBSTETRICS

PREGNANCY AND ITS COMPLICATIONS

Leverson, R. M., and McMillan, T. J.: Meat for Pregnant Women. *J. Am. M. Ass.* 1946 30:234.

The importance of adequate protein intake to mother and child has been well established. The investigators endeavored to see the results from the simple dietary recommendation "Eat plenty of meat—have a generous serving at least twice a day."

Private patients, all under 33 years of age, were selected. In addition to 3 regular meals per day they received 5 ounces of lean meat. Two control groups were used. All the women were about in the same stage of pregnancy and had the same hemoglobin. One group was given vitamin B complex supplement, while the other group received no supplement. These additions to the diet of meat and Vitamin B were begun early in the fifth month of pregnancy and continued for three months after delivery.

The women whose intake of protein was augmented by receiving a 5 ounce serving of meat daily had higher hemoglobin and red cell values, less edema, and more success in lactation than the women who received a supplement of B complex or those who received no supplement.

CATHERINE B. HESS, M.D.

Ware, H. H., Jr., and Winn, W. C.: Ectopic Pregnancy. *South. M. J.* 1945, 39 44.

The early diagnosis of ectopic gestation is dependent on the following:

- 1 Abdominal pain usually unilateral, frequently described as sharp lancinating stabbing or tearing, but sometimes cramplike and usually intermittent even though dull. The pain usually has a definite onset and is frequently noticed after exertion or defecation, and sometimes after intercourse. The severity of shock is in proportion to the rapidity of onset and the amount of internal hemorrhage.

- 2 A careful history which reveals an irregularity of the menses, either in interval or amount and in duration of the flow. Amenorrhea for one month or more is frequent in ectopic gestation.

- 3 The presence of a unilateral tender boggy pelvic mass, which was diagnosed in 60 patients, or 51 per cent.

- 4 Manipulation or pressure on the cervix. This causes severe pain in most cases.

- 5 Slight bloody vaginal discharge, which was observed in 75 per cent of the patients.

- 6 A rapid pulse rate associated with low hemoglobin, and a normal or slightly elevated temperature. This is very suggestive of ruptured ectopic gestation.

- 7 Pelvic examination. This should be extremely gentle and limited to one if possible.

Titus says "Expectant treatment for an ectopic pregnancy at any stage and in any location is highly

hazardous, as the sac may rupture without a moment's warning and the patient die from the ensuing hemorrhage." The authors emphasize that operation for removal of an ectopic pregnancy should be done as rapidly as possible after the diagnosis is made.

CHARLES BAROW, M.D.

Barnes, J., and Browne, F. J.: Blood Pressure of Relatives of Patients with Toxemia of Late Pregnancy (Preliminary Note). *J. Obst. Gyn. Brit. Empire*, 1945, 52 559.

The authors present a preliminary report on a study which is in progress to determine what part, if any, a familial tendency toward hypertension plays in the etiology of the toxemias of pregnancy. Estimations were made on 226 blood relatives of 130 patients who had been admitted to the obstetric unit of the University College Hospital in London because of toxemia. Estimations on a control group of 66 relatives of 47 patients who were normal were also made.

There was no demonstrable difference in the blood pressure recordings between the relatives of toxemic and those of the control patients except in the group of toxemic women with essential hypertension associated with pregnancy. In this group it was perhaps significant that 16 of 18 mothers showed definite hypertension.

GEORGE BRADSHAW, M.D.

Calvo, J. A.: Brow Presentation. Four Cases Observed in the Maternity Clinic in Bogota (A propósito de la presentación cefálica en posición de frente y de cuatro casos observados en la Clínica de Maternidad de Bogotá). *Rev. Obst. Gyn. Caracas*, 1945, 5 46.

In 4 instances of labor in brow presentation, all in young primiparas from 20 to 26 years of age, the pregnancy had been completely normal with delivery at term of normal babies of about normal weight from 3 060 to 3 740 gm. In all, the pelvis and birth canal was without abnormality yet the duration of labor was markedly beyond the normal for this type of presentation and no infant was delivered spontaneously. One child however was the only mortality.

In the first patient premature rupture of the membranes rendered manual dilatation of the cervix necessary. Attempts at conversion of the presentation into the face or vertex variety, and attempts at high forceps failed, and a dead child was delivered after 70 hours of labor by a high, laborious baco-tripsey. After this amount of manipulation the patient's puerperium was naturally stormy with fever, a painful uterus, fetid lochia, and endometritis.

In the second case the membranes were ruptured after nearly 4 days of labor and the cervix was dilated to a diameter of 3 cm. However after a further 7 hours of strong pains the head was still mobile

and dilatation had not greatly advanced a cesarean section was done with happy results for both the mother and child.

Opposition of the relatives to a cesarean operation and the slow but relatively favorable progress in the third delivery of this series induced an expectant attitude, at least until dilatation should be complete. This decision was made at consultation 33 hours after the initiation of labor at which the consultants insisted that delivery would occur spontaneously in a few hours. Yet 13 hours later after 5 hours of powerful labor pains and although dilatation was complete and the head had rotated from the mento-posterior to the mentoanterior position the membranes had not yet ruptured, and the consultants now acknowledged the necessity of interference. A difficult forceps operation resulted in the delivery of a living child.

In the fourth mother of this group the fetal head became fixed in the pelvis 16 hours after the initiation of labor and an hour later the membranes ruptured prematurely with rapid dilatation of the cervix. Eight hours later in the presence of continuous violent labor efforts the head became fixed in the right mentoposterior position a finger breadth from the perineum. A relatively easy forceps operation resulted in the extraction of a living child in the mentoposterior position.

His own experiences and a perusal of the medical literature brought the author to certain conclusions which he hopes may prove of value to the practicing physician.

These conclusions are rather briefly as follows:

1. Brow presentation causes grave dystocia even with a normal pelvis and small fetus.
2. Spontaneous delivery in this condition is rarely seen.
3. In the presence of concomitant complications cesarean section is frequently an adequate procedure and the least difficult one.
4. Recourse to sedatives and antispasmodics is of great value while waiting for spontaneous delivery and while preparing for intervention.
5. The technique of procedure should be chosen according to the individual case to safeguard the life of the mother and child the operator being guided, of course by the following considerations: (a) a reasonable period of waiting; (b) resort to cesarean section when vaginal delivery can be anticipated to cause difficulty and there is still time for surgery; (c) the use of forceps when the head is fixed in the pelvis with deep anesthesia and previous episiotomy; (d) symphyotomy if indicated and finally (e) basiotomy when the expectant period has proved a failure, or when negligence or lack of comprehension of the physician renders this disagreeable procedure obligatory.
6. Patients with brow presentation should be transferred to a specialized clinic or hospital to be cared for by a competent personnel and where everything will be ready to cope with any complication which may arise.

7. The obstetrician should be above everything a good doctor and combine common sense with his technical knowledge. JOHN W. BREXHAM M.D.

Thomas, R. C.: Rupture of the Rectus Abdominis Muscle during Pregnancy. *J. Obst. Gyn. Brit. Em.* 1945 52: 580.

The author reports on his second case of ruptured rectus abdominis muscle during pregnancy. The number of such cases reported in the literature is 31. Eighteen of the 31 cases gave a history of respiratory trouble 5 occurred with the onset of labor 2 followed a fall and 1 case occurred after labor during the course of typhoid fever. Of the 31 patients, 3 were primigravidae, 24 multigravidae, and in 4 the parity was unknown. The treatment in 20 cases was operation 4 of the patients died.

The difficulty in diagnosis is great, shown by the fact that in only 9 of 32 cases the correct diagnosis had been made.

The symptoms in the author's case that of a 34 year old para vi who was 33 weeks pregnant, were faintness pain in the right side and vaginal bleeding with a history of bronchitis for 2 weeks. Examination revealed Cullen's sign and an extremely tender uterus most of the tenderness being above the uterus. The hemoglobin was 49 per cent. Surgery was advised and 30 ounces of fresh and old blood were removed from the whole length of the posterior aspect of the rectus muscle extending up to the right costal margin and down to the symphysis pubis. All of the bleeding vessels were tied and the cavity was packed. Five days after the operation the patient went into labor and delivered a 3 pound 12 ounce stillborn female. CATHERINE B. HALL, M.D.

Shute, W., and Browne, F. J.: The Prevention of Premature Labor. *J. Obst. Gyn. Brit. Emphre* 1945 52: 570.

A series of 63 cases of threatened premature labor with a resultant salvage of 73 per cent is presented. This problem is acute according to some statistics. In 1941 there were 144,693 fetal and neonatal deaths in the United States. The estimated number of premature births in the United States in 1942 was 155,000 and 33,500 of the premature infants died in the first month of life. The solution of the problem does not seem to be in saving premature infants but rather in preventing premature births.

In this study it was found that a tendency toward premature labor could usually be predicted by finding a blood estrogen excess in early pregnancy. This occurred in 87 per cent of the 38 cases tested. A blood estrogen test is made routinely at the patient's first prenatal visit. This serves as a guide to the danger ahead.

Patients developing uterine tenderness, sacral backache spotting loss of amniotic fluid or a feeling of prolapse or impending menstruation are treated with Vitamin E. Only large daily doses of from 75 to 125 mgm of alphatocopherol are effective. These and larger doses can be given throughout pregnancy.

until term. This was the only therapy given with or without temporary rest in bed.

Among the 109 patients included in this and a previous report, there were 6 monsters and 93 normal living children delivered.

CATHERINE B. HESS, M.D.

LABOR AND ITS COMPLICATIONS

De Gouca, L. R. L.: Delivery of the Transverse Presentation (*O parto em apresentação cômica*) *Arch. brasil med.* 945 35 39.

This article comprises a rather complete discussion of delivery of the transverse presentation, and includes 38 references.

A brief historical review indicates that the condition was recognized even by the more primitive races and that they undertook some measures for its correction.

Consideration of the etiology, incidence, varieties, diagnostic maneuvers, clinical course, prognosis, and prophylaxis are presented in considerable detail as are the methods of treatment.

The author's own cases, 10 in number, were seen over a 4 year period. The incidence based on a 37 month period from June 1, 1941 to July 1, 1944, revealed transverse presentations in 0.64 per cent of 3,735 single pregnancies and in 5.3 per cent, for the second fetus, of 75 twin pregnancies. Of the 10 cases managed 8 were single pregnancies, 1 was of twin pregnancy (second child) and 1 was an abortion. The cause for this presentation in 9 of these cases was believed to be due to failure or inability of the uterus to maintain proper control over the fetus either because of laxity or flaccidity of the former or small size of the latter and in 1 case it was due to multiple pregnancy.

Two cases of spontaneous delivery occurred once by conduction corpore with a macerated 8 month premature infant and again by the mechanism of Douglas in an abortion occurring in the sixth or seventh month of pregnancy. Two cases were managed entirely satisfactorily by version and

extraction. Five cases in which the fetus was dead were managed by destructive operations—decapitation—without maternal injury. One case with ruptured uterus and peritonitis was seen the woman had been in labor more than 48 hours because of a prolapsed hand. Laparotomy was performed but the patient succumbed. HIRSH T. LAMORTON, M.D.

MISCELLANEOUS

Gordon, C. A.: Hemorrhage as the Most Frequent Cause of Maternal Death. An Analysis of the Puerperal Deaths in Brooklyn, 1944. *Am. J. Surg.* 945 70 77.

Each year since 1938 the Brooklyn Committee on Maternal Welfare has analyzed in detail the maternal mortality. In 1944 there were 51,082 births and 62 deaths, a rate of 12.4 per 10,000. This represents a reduction of 8.1 per 10,000 over 1943.

Thirteen deaths occurred early in pregnancy: 10 from abortion and 3 from ectopic pregnancy. Toxicemia was responsible for 11 deaths. 6 infants were undelivered. Infection caused the largest number of deaths—30. Cesarean section was followed by 8 deaths (6 from infection and 2 from hemorrhage). Ruptured uterus accounted for 6 deaths (3 spontaneous, 2 following version and extraction, and 1 after forceps delivery).

Hemorrhage was considered as the primary cause of death in only 8 cases and as a secondary cause in 3 more cases. However, in reviewing the cases the author states that serious hemorrhage occurred in 33 cases. He does not believe, however, that it was the primary cause of death in all instances.

Although definite improvement in the maternal mortality was noted, further advances can be made. The record of deaths from hemorrhage is proof that the precautions against death from this cause are inadequate. Blood plasma is not sufficient in replacing the lost blood, the importance of adequate amounts of whole blood cannot be overemphasized nor can delay in replacement be condoned.

J. ROBERT WILLIAMS, M.D.

GENITOURINARY SURGERY

ADRENAL, KIDNEY AND URETER

Larsen, K.: Method for Examination of the Function of Each Kidney Separately. *Acta med scand* 1945 123 56

The question of function of the individual kidney is highly important to the internist. The author found that insertion of ureteral catheters for measurement of individual kidney function was too inaccurate because urine ran alongside the catheters into the bladder. He presents a formula for calculation of the function of each side designating the amounts of urine produced by the right and left kidneys in the experimental period respectively as D and S , the amounts of urine collected through the right and left ureteral catheters respectively as d and s , and the bladder urine as Bl . He gives the following equation $D+S=d+s+Bl$.

If the urea concentration of the urine for the right and left ureteral catheters and from the bladder is respectively Ud , Us and Ubl the following equation is also true

$$DXUd+SXUs=d \times Ud+s \times Us+Bl \times Ubl$$

From these equations D and S and afterward the clearance from each kidney may be calculated easily. After introduction of the ureteral catheters the bladder is lavaged and emptied with a catheter after removal of the cystoscope. Then precisely 100 ml of water are introduced into the bladder and the collection of urine from the ureteral catheters commences. At the conclusion of the experimental period the portion of the bladder content which will run freely is evacuated. After this the collection of urine from the ureteral catheters is discontinued and immediately 50 ml. of water are injected into the bladder and withdrawn immediately after the first 10 to 15 ml. are discarded the following 10 to 15 ml are collected for analysis. If the urea concentration of this portion is designated as USk and the urea concentration of the bladder as Ubl that part of the bladder content that was not evacuated at once can be calculated from the equation

$$X \times Ubl = (X+50) \times USk$$

Therefore the amount of bladder urine is bladder content minus 100. In the second equation the last term is replaced by bladder content in ml $\times Ubl$. The results are controlled in the experiments by the determination of both the urea and creatinine clearance. This method is especially suitable for unilateral kidney lesions. Error may result in patients with pronounced hydronephrosis.

DAVID ROSENBLUM, M D

Rabotti F., and Magaldi, P.: Renobronchial Fistula (Fistula renobronchial). *Sem med B Afr* 1945 52 956

A woman, aged 39 years was admitted with complaints of persistent cough and pain in the left flank.

Nine years prior to admission she had had a stone removed from the left ureter and for 1 year she had had left serofibrinous pleurisy accompanied by renal colic.

One year prior to admission she had noticed a painful tumefaction in the region of the left kidney. A physician made an incision from which malodorous pus escaped. The remaining fistula has been treated with curettage local and oral administration of sulfanilamide, injections of prontosil and drainage. Injections of lipiodol into the fistula did not clarify the situation. Hemorrhagic purulent expectoration and subfebrile temperature did not yield to injections of calcium gluconate.

The local examination disclosed a fistula in the left costolumbar region from which a dense purulent secretion was escaping. The urine contained a considerable amount of pus. No tubercle bacilli were found in the sputum. The sedimentation rate of the erythrocytes was accelerated. X ray studies of the chest showed a diffuse shadow at the base of the left lung suggestive of a pachypleuritis. Poor elimination of uroselectan injected intravenously was noticed on the left side. Ascending pyelography showed sodium bromide solution in the left lung. Prontosil injected into the fistula appeared in the sputum. Indigocarmine injected intravenously appeared in the right ureter 5 minutes later while no dye was found in the urine from the left ureter for 15 minutes after the injection.

A left nephrectomy was performed and the patient made an uneventful recovery.

The authors conclude that a renobronchial fistula, although a rare complication should be kept in mind if a patient with symptoms of a previous renal or perirenal lesion complains of persistent cough with a purulent sputum. Nephrectomy usually cures the pulmonary process.

JOSEPH K. NARAT, M D

Fontaine, R., Forster E. and Ambard D.: Extirpation of the Aortorenal Ganglion in the Treatment of Painful Hydronephrosis (L'extirpation du ganglion aortico-rénal dans le traitement des petites hydronephroses douloureuses). *Rev chir* Par 1945 64 139

After unilateral nephrectomy the function of the remaining kidney is improved when the aortorenal ganglion is removed. The same favorable result is obtained in cases of painful hydronephrosis. The different surgical methods are discussed.

Resection of the splanchnic nerve and resection of the superior part of the lumbar sympathetic are mentioned as alternative methods to extirpation of the ganglion. In 7 of 9 cases the result was excellent. Partial improvement was obtained in 1 case and no success in 1.

Not only does extirpation of the ganglion give definite and lasting relief to the pain and colic, but it

improves the function of the kidney at the same time. It is still an open question whether the dilatation of the renal pelvis and ureter is also favorably influenced by the operation. The treatment is causal rather than symptomatic.

WERNER M. SOLMITS, M.D.

Cristol D. S., McDonald, J. R., and Emmett, J. L.: Renal Adenomas in Hypernephromatous Kidneys: A Study of Their Incidence, Nature, and Relationship. *J. Urol. Balt.*, 1946, 55, 18.

The resemblance between renal adenoma and carcinoma has been apparent to many pathologists.

The material used in this study was derived from surgically removed kidneys which were the sites of proved Grawitz tumors. A total of 567 kidneys and contained tumors were examined. The microscopic sections studied consisted of (1) 122 lesions suspected of being cortical adenomas, and (2) numerous sections of renal carcinomas located in the same kidneys from which proved renal cortical adenomas had been removed. The diagnosis could be verified in only 37 of the suspected renal cortical adenomas. All but one of these adenomas were largely papillary in structure. The exception was one that suggested an alveolar structure. As has been pointed out by many men writing on this subject, too often an adenoma will exhibit characteristics of more than one structural type. The largest adenoma in the series measured 4 mm. in diameter. The smallest was barely perceptible with a hand lens. More than 1 adenoma was found in 7 kidneys. The largest number of adenomas in any 1 kidney was 7. As with other investigators this series would indicate that there is an increasing prevalence of adenomas as well as of carcinomas in the decades past middle life.

Adenomas appear in the renal cortex as single or multiple grayish white yellow or brown nodules. They vary in size from that which is hardly discernible through a hand lens to the size of a walnut. Many are multiple and they are frequently found in both kidneys. Adenomas are seen to occur more frequently in kidneys containing clinical cancer than in significant series of kidneys examined at autopsy. Reasons are presented for considering adenomas as malignant growths.

Ackerman, L. V.: Mucinous Adenocarcinoma of the Pelvis of the Kidney. *J. Urol. Balt.*, 1946, 55, 36.

The case of a 66 year old man who presented a mucinous adenocarcinoma of the renal pelvis is reported. This is the first case recorded in the literature. The patient experienced attacks of renal colic at annual intervals 13 years. Eight years previously he was diagnosed as having a giant hydronephrosis and at that time a left nephrectomy was done. The kidney showed parenchymal destruction so that it was only a few millimeters thick in many zones. The pelvis and ureter showed alteration of the lining epithelium with evidence of chronic inflammation. Some areas showed squamous metaplasia and this

gradually underwent a transition to zones of piled up epithelium with vacuolated mucin containing cells which resembled morphology of the large bowel. In areas there were papillary projections similar to those seen in rectal polyps. The renal cortex showed hyalinized glomeruli and some cystic formation with flattened epithelial lining.

Six years following the nephrectomy a nonpainful swelling developed in the left flank along with abdominal enlargement which suggested intraperitoneal fluid and nodular masses. Under the left nephrectomy scar there was found an irregular mass firmly attached to the underlying structures. The urine showed much albumin with pus, bacteria, and occasional red cells. A needle biopsy of the mass showed a few cells forming acini, along with intracellular and extracellular mucin. The patient died within 6 months and the autopsy demonstrated a mucinous adenocarcinoma involving the liver, diaphragm, pleura, stomach, pancreas, and small bowel with lithiasis of the right kidney and squamous metaplasia of the pelvic epithelium. The significance of the spread is that it was not to the regional lymph nodes but resembled that of a pseudomucinous tumor of the ovary.

The author asks the interesting question as to why the left renal pelvis underwent glandular metaplasia and the right pelvis, squamous metaplasia.
ROBERT LACE, JR., M.D.

Fish G. W. and McLaughlin, W. L.: Liposarcoma of Kidney: Report of a Case Presenting an Unusual Syndrome. *J. Urol. Balt.*, 1946, 55, 28.

The authors report the case of a 28 year old white female with liposarcoma of the right kidney which is the eleventh such lesion reported and the seventh so reported in an individual with the tuberous sclerosis syndrome (knobby hardening of the brain). In addition, 3 additional cases in children are mentioned: (1) that of a boy of 7 years who showed tuberous sclerosis of the brain, and (2) that of a girl of 9 presenting the classical features of tuberous sclerosis, and although death ensued of cerebral lesions an autopsy was refused.

Tuberous sclerosis is discussed briefly in the article and attention is called to the concomitant findings of greasy gray red lesions of the face (adenoma sebaceum) in butterfly patterns and mental deficiency coupled with convulsive seizures. The presence of renal pathology is referred to and said to consist of either a single renal lesion although more often multiple bilateral neoplastic areas of primitive mesenchymal cell types (angio-fibro-endotheliomyo- and lipoblastomata) are found. The lesions are congenital deformities of the ectoderm and mesoderm, and demonstrate a strong hereditary factor. The individual with tuberous sclerosis seldom lives more than 30 years, and in every instance there is present the previously described skin lesion in 80 per cent of the cases the renal neoplasm is present. In a smaller percentage there is an associated rhabdomyoma of the heart, fibromatoma,

and malformation of other organs including the skeletal system.

The author's patient was seen repeatedly during a 4 year period. She had lesions of adenoma sebaceum and neurofibromatosis on her face back, and left fourth toe. There was a marked cardiac systolic murmur and a large abdominal tumor on the right side. There were no other significant findings except a profound anemia. Intravenous pyelograms showed an enlarged and distorted right renal pelvis. There was no familial history of tuberous sclerosis although one sister was confined for insanity and a brother was treated for intense phobias the patient herself was somewhat unstable emotionally.

The year before the patient was seen originally an exploratory celiotomy was done to ascertain the cause of fever abdominal tumor and anemia. A similar attack occurred a year later and the anemia on this occasion required the use of blood transfusions.

Three years later a similar attack of fever abdominal tumor, and anemia confined the patient to the hospital. On this occasion the tumor seemed larger. Another attack was experienced a year later and on this occasion the hydronephrosis showed progression along with elongation of the renal pelvis and calyces together with distortion suggesting hemorrhage. Upon nephrectomy the kidney substance was found to be almost completely replaced by various sized nodules of friable, grayish yellow tissue with nodules at the upper pole extending behind the liver. The total weight of the kidney tumor was 1,400 grams. The tissue showed cytologically encapsulated liposarcomas which were characteristically slow growing and nonmetastasizing but there was local recurrence and in addition, renal parenchymal compression.

The postoperative course was complicated by a severe transfusion reaction but at present (3 years following nephrectomy) the patient is working and claims to have unusually good health.

ROBERT LICH, JR., M.D.

Greene, L. F., and Kearns W. M. Circumcaval Ureter. Report of a Case with a Consideration of the Preoperative Diagnosis and Successful Plastic Repair. *J. Urol.* Balt. 1946, 55: 52.

The authors report a case of circumcaval ureter. This is the thirty third case reported the second preoperatively diagnosed and also the second successfully repaired surgically although it was the fifth in which such repair was attempted.

The patient was a 29 year old white male who had an attack of pain in the right costovertebral angle followed by the passage of urinary calculi a year prior to admission and then a recurrence of the pain 3 weeks before hospitalization. Excretory urography demonstrated a right hydronephrosis with dilatation of the upper third of the ureter which ended abruptly and at this point there was a gentle curve of the ureter with its convexity directed superiorly and medially the remainder of the ureter was normal.

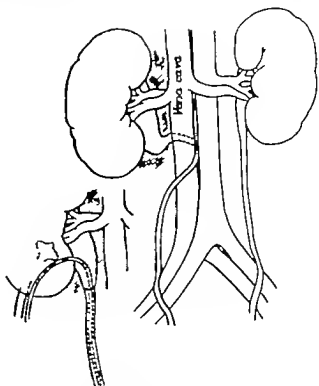


Fig. Findings at operation. Surgical repair shown in inset.

The operative findings and repair are depicted in Figure 1.

The authors conclude that there is need of prolonged ureteral splinting after anastomosis of the ureter since in this case early removal of the splinting catheter was the cause of much concern, and the repeated introduction of ureteral catheters was necessary in order to reduce and finally obliterate the extravasation present at the site of anastomosis. The anastomotic site was splinted and drained for the greater part of 39 days postoperatively and the urinary infection was controlled by the use of one of the sulfonamides. Seven months after operation, at the time this article was written the urine was free of infection or any abnormality and the patient was asymptomatic. The kidney was almost normal, but ureteral dilatations at regular intervals were considered advisable.

ROBERT LICH, JR. M.D.

Soley P. J.: Ureteropelvic Obstructions in Children. *J. Urol.* Balt. 1946 55: 46.

Ureteral stricture was found once in 150 children when Campbell studied 10,000 routine antopsies. In 34 per cent of this group of children ureteropelvic obstructions were found and in 62 per cent ureteropelvic obstructions. In another series of cases studied by Campbell and Bottomly the same relative proportion of stricture location was found and too a similar distribution was found in adults. The significance of aberrant vessels in ureteropelvic obstruction is controversial but the association of these vessels is not disputed.

The symptoms of ureteropelvic obstruction in children are pain in the back and flank, gastritis

testinal disturbances and the associated vesical disturbances in the presence of pyuria including hematuria. The finding of a flank tumor is a late sign and in the case of a poor prognosis for the surgical restoration of the involved kidney. The laboratory tests for renal function were not found to portray accurately the end results following surgery. The author found that retrograde pyelography with delayed emptying more accurately demonstrated the lesion than the information obtained with intravenous urograms.

Treatment was discussed under two headings: (1) ureteral dilatations in early lesions and (2) surgery when dilatations failed. The purpose of surgery is to relieve obstruction and the coexisting infection. Ureteropelvic obstructions are considered to be either of intrinsic or extrinsic etiology; the latter most commonly due to an aberrant vessel. The fundamentals of surgical intervention are discussed and the use of ureteral splitting catheters is emphasized.

Nineteen cases are reviewed: 10 were in males and 9 in females; the ages of whom varied from 8 months to 4 years. The left and right sides were equally involved and in 5 instances bilateral obstruction was observed. Of these cases 6 were treated by dilatation by the Foley operation which was followed by improvement; 1 case was treated by severance of the aberrant vessel and nephrectomy with postoperative dilatation and good result was obtained by a bilateral nephrostomy and the use of splinting catheters with severance of a lithiasis; poor results were obtained both sides. Nephrectomy was done in 5 cases; the result: 3 failures, 2 heminephrectomy relieved the obstruction. In the lower duct in cases and left a important amount of functioning tissue in 2 cases and patient with bilateral involvement refused treatment of any kind.

ROBERT LEON J. M.D.

BLADDER, URETHRA AND PENIS

Weyde, R. The Treatment of Tumors of the Urinary Bladder. *Acta Med. Stockh.* 945: 26-58.

Weyde reports 55 cases of bladder tumor treated from 1932 to 1942 at the N. Wegner Rad. m. Hospital, Oslo, Norway. The average age of the male patients was 55 years and that of the women 60.4 years. Sixty-eight patients had leucosarcomatous bladder carcinoma, 60 had malignant papilloma or papillomatous carcinoma and 53 were in such poor condition that no palliative treatment was not given.

In the first 560 cases after the opening of the hospital primary roentgen therapy was usually employed although since at this time the patients would have received combined surgical and radiological treatment with higher roentgen doses. At this time the author administers protracted fractional irradiation of the field two frontal and two back. If possible a total dose of at least 5,500 r is administered to each field approximately 150 r

being given daily. A total tumor dose of approximately 5,500 r or more is given with 175 kv., 4 ma., 50 cm. F.S. distance and 1 mm. Cu filter. At present the author does cystoscopic electrocoagulation only of very small papillomatous tumors with narrow noninfiltrated pedicles and bases. Larger tumors are coagulated openly through a cystostomy.

In young people with one or several small papillomas, cystoscopic coagulation is done and followed by careful postoperative observation. On young patients with larger and more widespread papillomas cystostomy, coagulation and implantation of radium needles are performed. In middle aged and older people bladder papillomas are always treated as a carcinoma and the author's present method consists of cystostomy, electrocoagulation of the tumor, implantation of radium needles in the wound bed and postoperative roentgen therapy as soon as the incision is healed. The author uses 10 mgm. radium element needles in 1 mm. of platinum from 3/16" apart and attached to metal wires so that they may be removed in 24 hours. After the radium implantation a roentgen dose of from 7,500 to 4,500 r divided on four fields is given. Widespread tumors which are not removable through a cystostomy are given primary roentgen therapy and at times the tumor is so reduced in size that subsequent radical electrocoagulation and radium implantation can be performed. No cystectomies have been performed in this series.

The author believes that in both papilloma carcinoma and in infiltrating carcinoma, routine postoperative roentgen treatment is indicated, unless cystoscopic treatment will suffice. He has not attempted the use of the McCarthy resectoscope or of transurethral implantation of radium needles. Of the 155 patients, 111 are dead of carcinoma. Of 77 patients, 12 (14.3%) are living symptom free after 5 years and 30 (38.9%) are symptom free after three years.

D. M. ROBERTSON, B.S.D.

Lazarus, J. A. Primary Malignant Tumors of the Retrovesical Region, with Special Reference to Malignant Tumors of the Seminal Vesicles: Report of a Case of Retrovesical Sarcoma. *J. Urol. Balt.* 946: 35-90.

A case of primary sarcoma of the seminal vesicle is reported, with a critical review of the literature. The author states that only 3 cases of primary sarcoma of the seminal vesicle (including his own) and 20 cases of primary carcinoma of the seminal vesicle have appeared in the literature. Since carcinoma of the prostate shows a tendency to invade the seminal vesicles the author believes that only 7 of the 20 reported cases of primary carcinoma of the seminal vesicles can reasonably be listed as authentic. In the remaining 13 cases the prostate was involved in the malignant process and it is therefore not possible to state with certainty that the lesion originated within the seminal vesicle.

This disease is most prevalent among aged men and the left seminal vesicle is involved slightly more

frequently than the right. Urinary symptoms ranging from increased frequency to acute urinary retention were present in approximately 50 per cent of the cases in which the symptomatology was noted in the protocols.

Metastases in the regional lymph nodes, the liver and the lungs were reported in 12 of the 20 cases. The mortality in this group was approximately 85 per cent.

Because of the inability in most instances to differentiate clearly between intrinsic tumors of the seminal vesicles and the tumors designated by Young as tumors of the retrovesical space, the author believes that it is more correct to designate this group of tumors involving the seminal vesicles as primary tumors of the retrovesical space.

FREDERICK R. LIEBERTHAL, M.D.

Leadbetter W. F. Repair of Complete Tear of the Membranous Urethra. Case Report and Suggested Technique for Operation. *J. Urol. Balt.* 1945 54: 549.

During wartime tears or ruptures of the deep urethra may be caused by penetrating wounds or fracture of the pelvis with displacement or separation of the pubic ram. The latter is the usual mechanism producing this injury in civilian life. Because of the proximity to other structures such as penis, bladder and rectum, more than one organ is commonly injured. As a general rule, pelvic fractures are also associated with other injuries and the mortality is high.

The diagnosis of complete tear of the membranous urethra is simple if the possibility of it is borne in mind. There is usually slight meatus bleeding. Voiding is impossible if the tear is complete. Rectal examination reveals absence of the prostate from its normal position behind the symphysis. Because of bleeding or the accumulation of urine and blood in the space behind the symphysis, a soft mass is felt filling this region. A sound or catheter passed into the urethra will be palpated after its passage through the triangular ligament directly beneath the rectal wall. The passage of a catheter does not result in the withdrawal of urine, though occasionally some blood may appear. Once the diagnosis is made, operation as soon as possible is necessary for the bladder will empty into the perivesical tissues.

The operation of choice is one which approximates the prostate to the triangular ligament and repairs the urethral channel. The perineal operation is carried out as a primary procedure, accomplishing this. Generally because of associated injuries, only a suprapubic cystostomy is possible at this time and repair of the urethra is left for a later date.

The author presents a report of the findings and treatment in the case of a 23 year old soldier with complete division of the membranous urethra caused by a tank accident. There was a complete tear of the membranous urethra associated with simple fracture of the pubis as well as multiple skeletal injuries. A primary cystostomy was done.

Later it was found that the prostate had retracted after the injury, the apex having been pulled upward and pointed backward toward the rectum. The vesical neck was elevated and pushed forward. A cavity existed between the two ends of the cut urethra. Some urine was passed rectally. Urethral operation was subsequently performed. The urethra was threaded upon a catheter throughout its lumen and the prostate was pulled down to the triangular ligament by two heavy silk traction sutures through the prostatic substance on each side of the midline which were passed through the triangular ligament and the perineal tissues out on to the skin of the perineum toward the scrotum. The proximal urethra was similarly brought forward with silk sutures brought out to the skin.

The author proposes a new operation which would accomplish primary reposition of the prostate and satisfactory apposition of the torn ends of the urethra by the suprapubic route, possibly to be done primarily at the time of the first injury. After threading the entire urethra over a Foley catheter, the prostate is brought to the triangular ligament by silk traction sutures which are passed behind the symphysis directly through the perineal tissues laterally and through the perineal skin at the base of the scrotum. No attempt is made to repair the urethra proper. A guide of some kind should be kept in the urethra during healing until it is certain that instruments can be passed from below. This operation suggests instead of simple cystostomy.

DAVID ROSENBAUM, M.D.

Schourup, K. Plastic Induration of the Penis. *Id. ed. of Stockholm* 1945 26: 315.

The pathology of plastic induration of the penis is obscure. It consists of the formation of a thick plaque of fibrous tissue in the tunica albuginea of the dorsum penis and is probably caused by vascular changes. Cartilage or bone is deposited in the lesion in about 10 per cent of the cases. The incidence of this condition is low (26 cases among 30,000 genitourinary patients reported by Zustin and 12 cases observed among 22,000 patients at the Radium Center in Copenhagen). The only certain fact is the association of this disease in many cases with Dupuytren's contracture which is also rare. Generally 10 per cent of the cases have been reported as having both affections. Hamann found this association in 23 per cent of his cases and the author in 40 per cent of the cases presented in the article.

The diagnosis is rarely doubtful. Occasionally roentgenogram will help to show calcareous deposits in the wall of the penis. For the differential diagnosis: gumma, gonorrheal cavernitis, leukemia or tuberculous infiltrates and malignant tumors might be considered. They usually can be recognized by their location and the presence of ulcerations.

The medical and surgical treatment of this disease as well as a method of irradiation is discussed. The treatment of 11 cases is reported. Twelve were

Irradiated with x rays with from 300 to 3,000 r in fractionated doses moderate filtration long distance and short distance arrangements varying with the case, and the testicles shielded 3 cases underwent surgery and 2 were both irradiated and operated upon. The results were as follows

Group	Results	No. of cases
Fully satisfactory		3
Nearly satisfactory		3
Unsatisfactory		4
Not followed up		

Groups	and Results	No. of cases
Satisfactory		3
Less satisfactory		1
Unsatisfactory		

The principal beneficial effect was the alleviation of pain during erection which interfered with cohabitation.

The author concludes that radiation therapy should be attempted first the method of application being of minor importance and only if it fails should surgery be recommended

GERHART S. SCHWARTZ, M.D.

GENITAL ORGANS

Borthwick, W M: Tuberculosis of the Male Genital Tract. *Glasgow M J* 1945 44 73.

The author's discussion of tuberculosis of the male genital tract is centered mainly on epididymitis. The age incidence is essentially that of the period of greatest sexual activity. Of 43 males with tuberculous epididymitis 88.3 per cent had at least one extragenital tuberculous lesion. He does not find that antecedent trauma or nontuberculous infection plays any significant role in the etiology of the disease. Diagnostic signs listed in increasing order of pathognomonic value are induration, enlargement and nodularity of the epididymis thickening of the vas deferens, involvement of the prostate and seminal vesicles, chronicity and bilaterality of the findings and tuberculous bacilluria. In the differential diagnosis gonorrhea syphilis, neoplasm non-specific infection, epididymal cysts, trauma and torsion of the testis, and venous thrombosis of the pampiniform plexus must be excluded.

Tuberculous epididymitis was found to be bilateral in 56.47 per cent of the author's cases. Involvement of the testis was found in 35.51 per cent, scrotal fistulas appeared in 41.04 per cent, and pelvic collateral lesions were present in 87.34 per cent. Sixty per cent of the patients suffering from tuberculous epididymitis were known to have renal tuberculosis. It is believed that the prostate is the link in the chain of infection between the kidney and the epididymis, and that the organisms reach the epididymis via the lumen of the vas deferens.

The treatment of choice is surgical removal of the epididymis. When epididymectomy is performed, contralateral vasectomy is advised to prevent

spread of the disease to the healthy side. The local prognosis is good but the general prognosis is that of generalized tuberculosis and is dependent upon conservative therapeutic measures and rest.

CLARENCE V. HODGES, M.D.

Odegaard, H.: On the Treatment of Malignant Tumors of the Testis. *Acta radiol* Stockh., 1945 26 345

In the 10 year period from 1926 to 1935 malignant tumors of the testes in Norway amounted to only 0.3 per cent of the total deaths from cancer in men. From a practical clinical standpoint they may be divided into two main groups: (1) seminomas (2) malignant embryonal testicular tumors. The genitule sarcoma (from the interstitial connective tissue) and the true carcinoma (from tubuli recti) are so rare that they have little significance. Malignant testicular tumors occur with equal frequency on both sides, and usually between the ages of 20 and 30.

The usual treatment today is orchidectomy with postoperative irradiation. It seems to be clear however from the various follow-up examinations published that roentgen treatment of teratomas does not prolong life. On the other hand it is beyond doubt that roentgen treatment of seminomas prolongs life. Hlman has advocated a radical operation, i.e. removal of the lumbar lymph nodes on certain indications. He is of the opinion that patients with teratomas without clinically demonstrable metastases should be subjected to radical operation and maintains that this operation is neither difficult nor dangerous.

If at the time of the orchidectomy lymph node metastases are not demonstrable, it probably does not matter whether the patient receives roentgen therapy or not. In case of incipient spread to the regional lymph nodes one may perhaps have hope of destroying these metastases. On the other hand, if the seminoma metastases have become clinically demonstrable one must count on only a temporary improvement.

At the Norwegian Radium Hospital, from 1935 up to and including 1941 37 cases of malignant testicular tumors have been treated. Of these 21 were seminomas and 16 were malignant embryonal mixed tumors (teratomas). The oldest patient was 71 years of age, the youngest (with a teratoma) 1 1/4 years. In 19 cases the right, and in 18 cases the left testis was affected. The Aschheim Zondek test was carried out in 14 patients with seminomas (all with negative results) and in 11 patients with teratomas, (with a positive result in 1). The reaction was of no prognostic value.

Thirty-four of the 37 patients had been operated on before admission to the hospital. In 3 the condition was inoperable.

Nineteen patients with seminomas and 13 with teratomas have received adequate postoperative irradiation. Of the patients with seminomas, 11 survived and were free from recurrence for 2 years or

more and 8 survived for 3 years or more. 2 have lived for more than 5 years. Of the patients with teratomas, 4 lived free from recurrence for 2 years or more and 3 lived for 3 years or more. Prior to irradiation one of the survivors for 3 years (with a teratoma) was subjected to a radical operation (Hilman's) at which time metastases of the lymph nodes were found.

Nine patients died from metastases within from 2 to 23 months after admission to the hospital and from 7 to 28 months after the onset of the symptoms.

JOSEPH K. NARAY, M.D.

MISCELLANEOUS

Lazarus, J. A.: The Prevention and Treatment of Delayed Wound Healing and Ulcerative Cystitis following Surgery for Tuberculosis of the Genitourinary Tract. *J. Urol.*, Balt. 1946 55: 160.

The incidence of genitourinary tuberculosis has greatly declined within the past two decades.

Postoperative fistula formation and wound disintegration are frequent complications following nephrectomy for tuberculosis.

The ureteral stump plays a negligible role in the production of fistulas.

Sinuses are more apt to occur in the more acute forms of tuberculosis than in the chronic. A combination of deep x ray treatment with ultraviolet radiation immediately following nephrectomy has almost completely eliminated this disagreeable complication and has been found to be an extremely effective method of managing sinuses which are already present.

Of the 63 cases forming the basis of this clinical study, 50.8 per cent revealed cavernous lesions of the kidneys removed, 31.8 per cent pyonephrosis, 8 per cent multiple abscesses, and in 9 per cent the kidneys disclosed the lesions only when sectioned. Bladder ulcerations were present in 63.8 per cent of the cases with cavernous tuberculosis of the kidney, in 45 per cent of the cases of pyonephrosis, in 100 per cent of multiple abscesses, and in 66.6 per cent of the cases in which the kidneys showed lesions only when sectioned.

The average number of x ray treatments given to patients with cavernous tuberculosis was 16.3, with pyonephrosis 13.6, with multiple abscesses 19, and with kidneys showing lesions when sectioned 16.7.

Deep roentgen therapy administered to the bladder is a distinct aid in alleviating bladder pain and in promoting the healing of tuberculous ulcerations.

It is recommended that this type of treatment start immediately after operation, since its greatest advantages are confined chiefly to the prevention of rather than the actual treatment of fistulas already established.

Of the newer agents for the treatment of complicated cystitis following nephrectomy for tuberculosis, the sulfonamides are highly recommended in all cases in which the urine from the bladder shows other organisms besides the mycobacterium of tuberculosis. Calceose, a derivative of creosote, has been found helpful.

A careful course of rigid hygiene, similar to that employed in the treatment of pulmonary tuberculosis, is mandatory in the postoperative management of all cases following operation.

JOHN A. LOEF, M.D.

INTERNATIONAL ABSTRACT OF SURGERY

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Irradiated with x rays with from 100 to 2,000 r in fractionated doses, moderate filtration long distance and short distance arrangements varying with the case, and the testicles shielded. 3 cases underwent surgery and 2 were both irradiated and operated upon. The results were as follows:

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GREGORY S. SCHWARTZ, M.D.

GENITAL ORGANS

Northwick, W. M.: Tuberculosis of the Male Genital Tract. *Gleason* 11: 3 945 144 173.

The author's discussion of tuberculosis of the male genital tract is centered mainly on epididymitis. The age incidence is essentially that of the period of greatest sexual activity. Of 403 males with tuberculous epididymitis 88.3 per cent had at least one extragenital tuberculous lesion. He does not find that antecedent trauma or nontuberculous infection plays any significant role in the etiology of the disease. Diagnostic signs are induration, enlargement and nodularity of the epididymis, thickening of the vas deferens, involvement of the prostate and seminal vesicles, chronicity and bilaterality of the findings and tuberculous bacillaria. In the differential diagnosis gonorrhea, syphilis neoplasm non specific infection, epididymal cysts, trauma and torsion of the testis, and venous thrombosis of the pampiniform plexus must be excluded. Tuberculous epididymitis was found to be bilateral in 56.47 per cent of the author's cases in lateral in 56.47 per cent was found in 87.35 per cent. Involvement of the testis was present in 87.35 per cent. Scrotal fistulas appeared in 41.09 per cent, and pelvic coincidental lesions were present in 87.35 per cent. Sixty per cent of the patients suffering from tuberculous epididymitis were known to have renal tuberculosis. It is believed that the prostate is the link in the chain of infection between the kidney and the epididymis via the lumen of the vas deferens. The treatment of choice is surgical removal of the epididymis. When epididymectomy is performed contralateral orchiectomy is advised to prevent

spread of the disease to the healthy side. The local prognosis is good but the general prognosis is that of generalized tuberculosis and is dependent upon conservative therapeutic measures and rest.

CLAUDE V. HOBBS, M.D.

Odegaard, H.: On the Treatment of Malignant Tumors of the Testis. *Acta radiol.*, Stockh., 945 26 345.

In the 10 year period from 1926 to 1935 malignant tumors of the testes in Norway amounted to only 0.3 per cent of the total deaths from cancer in men. From a practical clinical standpoint they may be divided into two main groups: (1) seminomas (x) malignant embryonal testicular tumors. The genuine sarcoma (from the interstitial connective tissue) and the true carcinoma (from tubal cells) are so rare that they have little significance. Malignant testicular tumors occur with equal frequency on both sides and usually between the ages of 20 and 50.

The usual treatment today is orchiectomy with postoperative irradiation. It seems to be clear however from the various follow-up examinations published that roentgen treatment of testis tumors does not prolong life. On the other hand it is beyond doubt that roentgen treatment of seminomas prolongs life. Hilmann has advocated a radical operation, i.e. removal of the lumbar lymph nodes on certain indications. He is of the opinion that patients with testis tumors without clinically demonstrable metastases should be subjected to radical operation and mastectomy. It is probably not a very difficult nor dangerous.

If at the time of the orchiectomy lymph node metastases are not demonstrable it probably does not matter whether the patient receives roentgen therapy or not. In case of incipient spread to the regional lymph nodes, one may perhaps have hope of destroying these metastases. On the other hand, if the seminoma metastases have become clinically demonstrable, one must count on only a temporary improvement.

At the Norwegian Radium Hospital, from 1925 up to and including 1941 37 cases of malignant testicular tumors have been treated. Of these, 11 were seminomas and 26 were malignant embryonal mixed tumors (teratomas). The oldest patient was 75 years of age, the youngest (with a testis the left) was 19 years old. The Aachheim-Zondek test was carried out in 14 patients with seminomas (all with negative results) and in 11 patients with teratomas (with a positive result in 1). The reaction was of so prognostic value.

Thirty-four of the 37 patients had been operated on before admission to the hospital in 3 the condition was inoperable. Nineteen patients with seminomas and 13 with teratomas have received adequate postoperative irradiation. Of the patients with seminomas, 11 survived and were free from recurrence for 2 years or

more and 8 survived for 3 years or more 2 have lived for more than 5 years Of the patients with teratomas, 4 lived free from recurrence for 2 years or more and 3 lived for 3 years or more Prior to irradiation one of the survivors for 3 years (with a teratoma) was subjected to a radical operation (Hilomans) at which time metastases of the lymph nodes were found.

Nine patients died from metastases within from 2 to 23 months after admission to the hospital and from 7 to 28 months after the onset of the symptoms.

JOSEPH K. NARAT M.D

MISCELLANEOUS

Lazarus, J. A.: The Prevention and Treatment of Delayed Wound Healing and Ulcerative Cystitis following Surgery for Tuberculosis of the Genitourinary Tract. *J Urol Balt.* 1946 55 160.

The incidence of genitourinary tuberculosis has greatly declined within the past two decades

Postoperative fistula formation and wound disintegration are frequent complications following nephrectomy for tuberculosis

The preteral stump plays a negligible role in the production of fistulas

Sinuses are more apt to occur in the more acute forms of tuberculosis than in the chronic. A combination of deep x ray treatment with ultraviolet radiation immediately following nephrectomy has almost completely eliminated this disagreeable complication, and has been found to be an extremely effective method of managing sinuses which are already present

Of the 63 cases forming the basis of this clinical study 50.8 per cent revealed cavernous lesions of the kidneys removed 31.8 per cent pyonephrosis 8 per cent multiple abscesses and in 9 per cent the kidneys disclosed the lesions only when sectioned Bladder ulcerations were present in 63.8 per cent of the cases with cavernous tuberculosis of the kidney in 45 per cent of the cases of pyonephrosis in 100 per cent of multiple abscesses and in 66.6 per cent of the cases in which the kidneys showed lesions only when sectioned

The average number of x ray treatments given to patients with cavernous tuberculosis was 16.3 with pyonephrosis 13.6 with multiple abscesses 19 and with kidneys showing lesions when sectioned 16.7

Deep roentgen therapy administered to the bladder is a distinct aid in alleviating bladder pain and in promoting the healing of tuberculous ulcerations

It is recommended that this type of treatment start immediately after operation since its greatest advantages are confined chiefly to the prevention of rather than the actual treatment of fistulas already established

Of the newer agents for the treatment of complicating cystitis following nephrectomy for tuberculosis the sulfonamides are highly recommended in all cases in which the urine from the bladder shows other organisms besides the mycobacterium of tuberculosis. Calceosol a derivative of creosote, has been found helpful.

A careful course of rigid hygiene similar to that employed in the treatment of pulmonary tuberculosis is mandatory in the postoperative management of all cases following operation

JOHN A. LOEY M.D

SURGERY OF THE BONES JOINTS MUSCLES, TENDONS

CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Summary T. J., and Pressly C. L.: Sarcoma Complicating Paget's Disease of Bone. *Ann Surg* 1946, 23: 35

Sir James Paget in 1852 saw the first patient with the disease which he later described as osteitis deformans. Altogether he saw 23 cases and his classic description of this spongy hypertrophy of bone is still unsurpassed. It begins in middle age or later is very slow in progress and may give no other troubles than those which are due to the change of shape, size and direction of the diseased bones. It affects most frequently the long bones of the lower extremity and the skull and is usually symmetrical. The bones enlarge and soften, those bearing weight weaken and become unnaturally curved and misshapen. The spine may sink and seem to shorten, but the limbs however misshapen remain strong. But to support the truth, Verchow suggested leontias ossea as a name for the cases in which the disease is limited to the skull and facial bones.

Early in the disease when the connective tissue has replaced much of the original bone, there is bowing of the softened weight bearing bones. As cancellous bone is subsequently laid down in large amounts the cortices become thick and hard and the typical mosaic pattern of lamella develops with fibrous tissue replacing the marrow.

The cause is still unknown but the original acceptance of a chronic inflammation tends to be replaced by the concept of some endocrine cause, the parathyroid seeming to be the most probable offender. Serum alkaline phosphate is high but as yet no other biochemical findings contribute to a solution.

Since many cases of Paget's disease are relatively asymptomatic the incidence rate is dependent upon the extent of the routine roentgenological studies, and may be as high as 10% in 600 patients. Eight of Paget's 23 patients died, his only observation (5 of malignant lesions) and this tendency has been emphasized by many students. Sarcomatous degeneration of bones of Paget's disease is found in from 5 to 40% of the patients according to most authors. The few who question this high percentage still admit a greater incidence than in the general population.

The predisposing factor remains a moot question, but Jaffe's belief that the tremendous proliferative capacity of the tissue involved in polyostotic Paget's disease may in itself be the basic stimulus for tumor formation seems most reasonable. The multiple bone involvement when it occurs is spared lends further credence to this idea. The incidence of osteitis deformans is greatest in patients more than

40 years of age with males apparently predominating among both the cases of the basic disease and those with complicating sarcoma.

To 73 cases of sarcoma complicating Paget's disease collected from the literature, the authors have added their own 3 cases. Localization of the sarcoma favors the femur, humerus, skull and tibia, in that order and the scapula, vertebra, and ilium next most frequently. The prognosis is grave for there is no known cure. Early amputation with or without previous roentgen therapy is the treatment of choice and roentgen therapy alone may be palliative in the terminal stages.

The 3 new cases are presented with illustrative roentgenograms and photomicrographs, which established the diagnosis confirmed at autopsy. A complete bibliography is included.

THOMAS L. BERNACKER, M.D.

Diaz, B. R.: Chronic Tuberculous Synovitis of the Wrist (Sinoitis crónica tuberculosa de la muñeca). *Rev. A. med. argent.* 1945, 50: 17

The cases reported were of the author's own personal experience and are presented because chronic tuberculous synovitis of the wrist does not seem to have been previously reported in the Argentinian medical literature. Also, several aspects of the author's experience seem worthy of special notice. The first was that of a robust officer of the maritime service in whom the bursa of all the tendons on the dorsal and lateral aspects of the left wrist had become progressively involved in a painless swelling with a sensation of rice grain sensation following a blow over this point 5 years previously. The second case was that of a woman of 22 years with a similar history except that there was no known trauma and the process involved both wrists. In her case the duration of the condition was 3 years.

The operation was essentially under Kulenkamp's brachial plexus anesthesia. In the first case and under nerve trunk and peripheral infiltration with novocain (1%) in the second. An incision was made down the middle of the back of the wrist and skin flaps were held back on each side. The posterior ulnar ligament of the wrist (ligamentum carpi dorsale) was incised with apparently a separate incision made directly into each osteofibrous compartment. Each bursa was carefully dissected free down to its attachment to the tendon itself.

In loosening the bursa from the ligament, that portion of the latter which seems badly diseased may be cut away with the bursa, to leave only sufficient tendon substance to assure continuity or if the ligament has lost its continuity it may be reanastomosed by tendon transplantation. It will usually reconstruct itself. An attempt may be made to reconstruct the osteofibrous compartment, although this again seems to be optional as the posterior annular

ligament also shows a tendency to reconstitute itself. The wound surfaces were powdered with iodoform and the skin was sutured to leave merely filiform drainage. The part was put up on a posterior plaster splint for from 8 days to 2 weeks when the stitches and drain were removed and the splint was reapplied with however daily sessions of mobilization of the fingers.

Rich and abundant food, vitamins and calcium were provided and in the second case the condition of the other wrist improved so much following the operation that the projected operation for this wrist was not required.

The author's experience gives one the impression that the lesion reported might be susceptible to tuberculin therapy. JOHN W. BRENNAN, M.D.

Kjelland, P. M.: A Rare Anomaly in the Elbow. *Acta radiol.* Stockh. 1945, 26: 491.

The author presents two cases of patella of the elbow joint.

The first case was that of a washer woman 51 years of age. She suffered two minor injuries to the left elbow, one when a small child and the other at the age of 40, neither of which was treated medically. She also had rheumatism for many years, but with out particular localization to the left elbow. The recent study was brought about by a slight injury to the left elbow 4 days prior to the examination.

Roentgenograms of the left elbow in various views and under different angles revealed what appeared to be a patella of the elbow joint. Under fluoroscopic control this accessory bone was found to move with the olecranon from maximum flexion to the mid position then from the mid position to maximum extension. The upper pole moved forward and finally came to rest with the axis of the patella perpendicular to the axis of the ulna (Fig. 1). Injection of the elbow joint with 20 per cent perabrodil revealed that the contrast medium entered between the olecranon and the anterior aspect of the patella which seemingly was covered with cartilage. In addition there was evidence in this case of arthrosis deformans.

The second case, that of a 73 year old man without a history of previous injury, arrived for examination because of rheumatic pain in the left elbow over a period of several years. Roentgenograms revealed a chestnut shaped accessory bone with a slight concave anterior surface just above the olecranon which was thought to represent a patella of the elbow.

In connection with these 2 cases the author reviewed the medical literature. He was able to collect 15 additional cases. In 11 the diagnosis appeared certain. In the remaining 4, doubtful. In the majority the extension of the elbow was impaired and during movement the bone turned into the fossa of the olecranon as if there was a joint between the posterior surface of the olecranon and the anterior surface of the patella. The posterior surface of the patella serves as a place of attachment for the triceps ligament. Several of the cases re-



Fig. 1. Patella cubiti. The dorsal surface where the triceps ligament is attached the smooth anterior surface which is probably covered with cartilage. Arthrosis deformans, 3 different phases of the joint movement.

viewed showed in addition, characteristic changes of arthrosis deformans. It must therefore be assumed that elbow joints with patellae are predisposed for this affection. Otherwise the symptoms are few and patients afflicted with it are able to work.

The etiology is not altogether clear. The author prefers to assume an embryonic origin for several reasons. It is known that the olecranon sometimes has two points of ossification, one of these develops into the olecranon process of the ulna and the other into an accessory olecranon. By the same mechanism the second point of ossification may develop into a patella of the elbow joint. The origin from a pseudarthrotically healed olecranon fracture as advocated by others is contradicted by the fact that in only 2 of the reviewed cases was there evidence of definite trauma. Moreover in 4 cases the condition occurred bilaterally and in 1 instance it was found in father and son. Finally there is ample proof that patella of the elbow joint is encountered in the animal kingdom, for example in frogs and lizards, in birds, bats, insect eaters, rodents, and one of the edentates.

T. LUCUTIA, M.D.

Lapidus, P. W.: Spastic Flatfoot. *J. Bone & Sw. Surg.* 1946, 28: 126.

Painful so-called spastic rigid or contracted flat foot is a clinical entity vaguely described in most textbooks. Most investigators have believed that the condition is an advanced phase of flaccid flatfoot wherein faulty mechanics set up a reflex spasm of the plantar muscles because of irritation in the subtalar region.

A review of the literature presents no more apt conclusion than those voiced by Todd who offers a concise summary of the present state of our ignorance and agrees with the present author's belief that treatment of the spasm alone is not rational. Spasm is not the disease but the result of the disease and manipulation with immobilization in various plantar physiological positions, the valgus position being a position of rest for the involved joint.

It is generally agreed that the condition is painful with spasm limited to the pronator group. Trauma or occupational strain is noted appreciably often. The onset frequently occurs during adolescence. The incidence is slight compared to the large number of flaccid flatfeet seen. There are various interpretations of the facts that pes planus is not always present and that a normal or even cavus condition of the longitudinal arch may concur. Tenderness has been noted both on the lateral and medial aspects of the foot. The role of arthritis of the subtalar joint is variable.

The author presents the anatomy and mechanics of the subtalar joint graphically and gives a logical explanation for the pronator spasm. Any lesion of the interosseous talocalcaneal ligament, regardless of etiology, may induce the syndrome appropriately called "spastic subtalar lesion." The subtalar joint surfaces may or may not be involved and pes planus is not necessarily a part of the syndrome.

The author classifies cases of the disorder according to the extent of the pathological changes, and outlines the treatment appropriate for each type. Drastic procedures aimed at the elimination of pronator spasm are unsound and often dangerous.

FRANCES E. BISHOPWECK, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Higgs, S. L.: The Use of Cancellous Chips in Bone Grafting. *J Bone Surg* 94b 33 5.

Seventy-one consecutive cases of bone grafting were reviewed by the author 63 of which were operations for nonunion of the long bones. Among the latter group, cortical grafts alone were used in 20 cases and cortical grafts plus cancellous chips were used in 40 cases. All of the operations resulted in union, although in 4 patients reoperation was required.

The 10 other cases were osteoclastomas, solitary cysts and osteitis fibrosa cystica, and arthrodeses, in all of which cancellous chips were used to fill the bone defects.

For successful use of cancellous chips, rigid fixation is necessary. The author has used a screwed-on onlay graft for the humerus, an onlay or inlay for the radius and ulna, a sliding inlay or onlay from the other leg for the tibia, and a screwed-on onlay graft for the femur.

Sclerosed bone must be removed as well as all scarred and fibrous tissue. Bare muscles should be brought in contact with the bone whenever possible. Skin grafting may be necessary.

Despite the fact that many of the cases had recently been septic, bone grafting was done. Penicillin and sulfanilamide powder were applied.

Bone chips hasten the time of union by approximately 5 per cent. The chips with cortical grafts add in filling gaps in the long bones and defects in cysts and in filling gaps and crevices in arthrodesis operations.

DANIEL H. LEVINTHAL, M.D.

Ernst J.: Canalization of the Femoral Epiphysis According to Duverney (Le forage de l'épiphyse fémorale de Duverney). *Acta radiol* Stockh 1945, 36 76.

Duverney popularized drilling of the femoral epiphysis as the method of treating arthrosis of the hip. For this purpose he uses a drill 6 mm. in diameter which makes a channel through the femoral neck and head.

Contradictory opinions regarding the mode of action of the operation have been advanced by various authors. Some claim that the procedure is followed by a diminution of the hyperemia which is responsible for rarefaction of the bone. This hypothesis is based on oscillographic measurements which show larger excursions before than after the operation. Others maintain that the hyperemia following the operation produces granulations of the bony structures. This result is compared with the sequelae of drilling the bone in cases of pseudarthrosis.

Results of the operation reported by various authors differ to a great extent. This may be due to variations in the length of observation or to differences in the pathological conditions. From the anatomopathological point of view some writers differentiate two types of arthrosis of the hips: (1) the sclero-osteophytic type in which sclerotic bone tissue and cysts are found (this type has a slow evolution and limitation of motion is more pronounced than pain) (2) the type which is characterized by atrophic alterations and rarefaction. In the latter type osteophytic formations are soft, and the osseous rarefaction and formation of cysts are marked. The cysts, contrary to those in the first type, are not surrounded by sclerotic tissue; they are soft and compressible. The lesions develop rapidly and cause much pain. This type of arthrosis yields the best results after drilling.

The author performed canalization of the femoral epiphysis 41 times in 30 patients, 2 of whom were treated on both sides. The drill used was 5 mm. in diameter. In the majority of the cases several canals, up to 8, were drilled; the average number being 3 or 4. Of the 41 operations, 19 were done in women and 22 in men. The lesion was present on the right side in 23 instances and on the left side in 18. The ages of 19 patients ranged from 31 to 60 years; of 11 from 61 to 70 years; of 6 from 41 to 50 years; of 3, from 31 to 40 years; and of 2, from 71 to 80 years. The duration of symptoms in 5 of the patients exceeded 5 years. In 33 cases the condition was primary ilio-patitic, and in 8 it was secondary following a contusion of the hip, fracture of the femoral neck, congenital dislocation, or coxa vara.

As to the complications, 2 patients developed a hematoma, 2 developed phlebitis, 1 pneumonia, and 1 paresis of the peroneus muscle. In 4 patients a tenotomy of the adductor muscle was performed immediately following the drilling or a few days later.

A follow-up of 6 months after the operation showed the condition to be improved in 76.4 per cent and

unchanged in 23.6 per cent the respective figures after two years were 70.1 and 29.9 per cent, and after six years 64.3 and 35.7 per cent, respectively. After six years 53.6 per cent of the patients had no pain at all, while in the remaining 9.7 per cent of improved cases the amelioration was partial as far as pain and limitation of motion were concerned.

In cases favorably influenced by the operation the cysts and osseous rarefaction subsided to a great extent, being replaced by a solid tissue while in cases in which failure was recorded, sometimes an increase of the number of cysts and rarefaction of bone were found. The operation apparently was not followed by a diminution of the osteophytic formation or decrease of deformity of the femoral head in either group.

JOSEPH K. NARAT, M.D.

FRACTURES AND DISLOCATIONS

De Luca, G., and Farina, M. G.: *The Treatment of Compound Fracture and the Closed Plaster Method* (La cura delle fratture esposte ed il metodo degli apparecchi gessati chiusi). *Polidina* (1st part) 1945 54 403.

The closed plaster method used by the authors in both civilian and military practice for compound fracture is essentially that developed by Orr and later by Trueta, the circular plaster cast being applied directly to the skin according to the principles laid down by Boehler following the first World War.

In the authors' own material consisting of 1,886 open fractures 151 cases occurred in civilian life and 1,735 were due to war. The closed plaster method was used in 137 civilians (90 per cent) and in 1,320 soldiers (76 per cent). In civilian practice good results were obtained with this method in 78 per cent of cases, mediocre results in 10 per cent, and poor results in 12 per cent. In military practice good results were obtained in 73 per cent, mediocre results in 13 per cent, and poor results in 15 per cent. However the slightly higher percentage of unsatisfactory results in military practice is not a fair comparison because of the higher percentage of serious fractures. For instance there were four times as many leg fractures as those of the femur in civilian patients while in the military material fractures of the femur predominated markedly. Primary soft tissue suture could be done in 112 of the civilian patients, but was not attempted in the war material. In civilian practice there was not 1 instance of gas gangrene or of tetanus while there was a single example of each in the war material.

The case with tetanus, an open fracture of the lower third of the right leg was of especial interest in that the patient was erroneously twice given tetanus antitoxin on succeeding days immediately after the injury on the tenth day there were clear indications of tetanus infection, which however disappeared under the usual therapy.

The authors' primary treatment of the wound which they call mechanical sterilization and which

they seem to distinguish from excision of the wound, consists of freeing the wound from blood clots, all foreign material, and devitalized tissues especially muscle tissue and detached bone splinters. It is initiated—if the condition of the patient permits—under intravenous eunarcosis anesthesia after 1 or 2 hours in order that the patient may recuperate from any initial shock. An attempt is made to bring the blood pressure to about 110/65 and diagnostic or other manipulations of the injured part are kept to the minimum. At this time an attempt should be made to appose the bone fragments before they are incased in the plaster and even in the cleanest wound perhaps with primary suture sulfa drugs should often be insufflated into the wound.

The surgeon must first be assured of the vitality of the limb with extension in a Thomas or Braun splint (perhaps for a few hours at first) and close watch must be maintained at all times during the succeeding days. In fact it may at times prove hazardous to enclose the limb of a wounded man in plaster in wartime if he must be transported immediately and transferred to the care of other surgeons who may not be aware of the importance of the lesion.

JOHN W. BRENNAN, M.D.

Kirby, C. K., and Flitt, W. T., Jr.: *The Incidence of Complications in the Use of Transfixion Pins and Wires for Skeletal Traction*. *Ann. Surg.*, 1946 123 27.

At a General Hospital in India, 342 transfixion pins and wires (195 Kirschner wires, 95 Steinmann pins and 52 Roger Anderson pins) were used in the treatment of 333 fractures of the long bones. Three hundred and five pins and wires were observed during the entire period of their use and were removed at the hospital.

Among the 305 transfixions there were 12 complications as follows: soft tissue infection without osteomyelitis or the formation of a chronic draining sinus at the site of a Steinmann pin; loosening of 4 Kirschner wires; loosening of 3 Roger Anderson pins; 2 cases of transient peroneal nerve palsy; breaking of 1 Kirschner wire and slipping of 1 Kirschner wire bow. It is believed that the last 11 complications were avoidable, and in no case did a complication have any significant effect upon the course of treatment or the final result. The final results of treatment are not described in the article.

After an observation period of from 5 to 6 weeks there were no complications in the 37 transfixions in which the final result was unknown. Prophylactic sulfa drugs were administered to approximately 60 per cent of the patients either because the fracture was compound or because of associated injury or disease and no infection developed in this group. Since infection occurred in only 1 of the 40 per cent of patients who had not received sulfonamides and it is not at all certain that a sulfonamide would have prevented this infection, there is no statistical evidence that prophylactic sulfonamides played a part in preventing infection at the pin site.

in this series. In no instance was a prophylactic sulfonamide used for the sole purpose of preventing infection at the pin site.

CHARLES A. WATMAN, M.D.

Robertson, R. C., Cawley, J. J., Jr., and Faris, A. M.: The Treatment of Fracture Dislocation of the Interphalangeal Joints of the Hand. *J Bone Surg* 94b 58 68

Fracture dislocation of an interphalangeal joint of the hand is an uncommon injury and in the absence of adequate treatment results in severe permanent disability. Reduction is difficult to maintain by conservative methods of splinting, because of pressure necrosis of the soft tissues and the authors recommend a method of multiple skeletal traction which they employed successfully in the treatment of 7 cases of this type.

The finger is prepared for surgery and is covered with a sterile dressing. A plaster-of-Paris cast is applied from the proximal palmar crease high onto the forearm and a wire banjo splint is incorporated in the desired position. Under general or local anesthesia a small Kirschner wire is inserted transversely through the neck of the phalanx proximal to the dislocation and another wire is placed transversely through the base of the phalanx distal to the dislocation. A third wire is passed transversely through the neck of the middle phalanx if the injury involves the proximal interphalangeal joint. If the distal interphalangeal joint is involved the third wire is passed transversely or vertically through the distal phalanx. A small temporary dressing is applied about each protruding wire. The wire is then cut and fashioned to form a traction bow. To each of the bows a rubber band is attached and fixed to the banjo. The involved joint is then flexed to from 30 to 30 degrees and the desired traction is applied to each band at such an angle as to secure reduction of the displacement.

In the 7 cases treated by the authors the shortest period of traction fixation was 2 days and the longest was 30 days. There were no operative infections and excellent functional results were obtained. All 7 cases reported were caused by the patients being struck on the end of the extended finger by a baseball or softball. CHARLES A. WATMAN, M.D.

Soto-Hall, R., and Horwitz, T.: Compound Fractures of the Femur. *J Am Med Ass* 94b, 3 28.

The late results of treatment of femoral fractures are reviewed in an attempt to throw light on the etiology of such complicating factors as sepsis, nonunion, deformity and knee stiffness. The series includes 17 compound fractures of which 7 had been treated by early internal fixation. To obtain the proper standard for comparative study, 46 simple fractures are included of which 24 had been treated by early internal fixation.

A very high proportion (80%) of compound fractures without internal fixation healed without

sepsis. When this group is added to the 44 per cent classified as mild infections because they represented mainly soft tissue sepsis and healed within 5 to 8 months, the whole picture presents a brilliant achievement of war surgery.

The infected fractures (17%) include many cases of extensive loss of soft and bony tissue with vascular damage in which sepsis is almost unavoidable. In cases treated by early internal fixation through an open wound, the incidence of severe sepsis was about 50 per cent higher than in patients treated without metal fixation. In the cases of most of these men the plates or metal had to be removed. In some cases severe infection appeared to be under control for several weeks while chemotherapy was being administered later the infection became clinically evident.

The following procedure seemed to offer the least danger for the type of fracture in which internal fixation appeared indicated.

A thorough débridement was done early, and was followed by delayed closure of the wound from 7 to 10 days later. After the original wound had healed in an average of 6 days the fragments were approximated through a separate longitudinal incision and held together by metal fixation. In some types of fracture the use of screws has given better results than the plate probably because of less surgical trauma.

Chemotherapy included the use of penicillin or a sulfonamide compound, or both. The findings confirm the fact that modern antibacterial agents may produce excellent results in the control of infection and in the reduction of complications, but that they are impotent in the presence of tissue which has lost its blood supply and which does not allow the drug to come in contact with the infection.

Cases in which union occurred within a period of from 5 to 7 months were classified as delayed union cases showing neither clinical nor radiological evidence of bone union beyond 7 months were classified as having reached the stage of nonunion. Considering the frequency of severe injury with comminution and absence of bone fragments, the proportion of bone union which occurred in cases treated by external splinting was extremely high, 86 per cent and definitely higher than the finding in fractures treated by internal fixation. A comparison of the time required for union in simple fractures treated by open and by closed methods demonstrates that in spite of the improved apposition of fragments in the open cases, there was little difference in the period needed for bone healing. The state of delayed union and of nonunion appears directly related to the degree of bone loss or damage, distraction and the presence of infection. Distraction even of a very minimal amount, is particularly harmful.

A comparison of the results with respect to restoration of knee motion in men treated by internal fixation and in men treated by traction showed no appreciable difference. The findings were not en-

tirely conclusive because in a number of patients who had had repairs or delayed union the splinting had been too recent. The average period from the date of injury to the last examination was only 9½ months so that the statistics do not indicate the final result but do describe the slowness in restoration of joint motion. Two factors which were found to be definitely helpful were the use of restative exercises and the use of delayed closure. Successful delayed closure resulted in much earlier healing and less scarring so that exercise and activity could be started earlier. An important disability was a limitation of extension of from 5 to 10 degrees in about one-third of the cases. This disability could be overcome after several weeks of active exercise, but its occurrence argues in favor of treatment of fractures above the lower third with the knee in full extension.

Other complications were refracture in 5 patients and renal lithiasis in 6 patients.

The authors conclude that early and adequate débridement is the most vital factor in the successful treatment of compound wounds and that conservative treatment of traction in balanced suspension gives extremely gratifying results.

JOHN L. LINDQUIST M D

King, T: Slowness and Failure of Bony Union after Fractures and Osteotomies of the Proximal or Trochanteric End of the Femur. *Austral N Zealand J Surg*, 1945 15 33

Nonunion is very rare in extracapsular lateral or intertrochanteric fractures of the femoral neck and low union is the rule. In the past 10 years the author has seen only 2 cases of nonunion of fractures of these types. Prolonged immobilization provokes complications and difficult nursing problems which may be obviated by internal fixation by the Blount and Moore blade apparatus the nail and plate method of Jewett or Hawley and other similar methods. In addition more rapid osseous union results because of good reduction firm apposition of the fractured surfaces and absolute immobilization. The Stader or any other form of splinting which requires that the bones be transfixed by ¼ inch nails above and below the fracture site and attached to some form of external holding apparatus is considered too dangerous because of the infection along the pins that must inevitably occur in a certain proportion of cases.

Fractures at the base of the neck and between the tip of the greater trochanter and lesser trochanter can be treated with the Smith-Petersen nail and no supplementary plate is required. When the fracture is situated distal to the level of the lesser trochanter a plate is attached to the Smith Petersen nail. In the reduction of fractures of this type, coxa vara should be overcome on the orthopedic table by traction and abduction but the external rotation that is present in most cases should not be corrected by internal rotation of the limb as is carried out in intracapsular fractures. Accurate reduction is ob-

tained by allowing the limb distal to the fracture to remain externally rotated about 45 degrees from the vertical plane and thereafter correcting any differences in the angles of rotation between the fractured fragments by pulling forward the trochanteric fragment with a sharp hook. When the nail is introduced the angle of declination is forward from 25 to 45 degrees instead of backward. At least 1 to 1½ inches of the head end of the nail should stand out before the plate is attached, as it will be impossible to attach the plate if the nail is driven all the way in. A modified Hawley plate with a reamed ring is used and is attached to the tapered head of the nail. It provides a strong fitting especially when fixed down by the screw. When the angle between the plate and reamed ring is to be altered so the plate is parallel with the femoral shaft another taper headed nail should be used for the adjustment while the plate is held in a sterile towel. Levers, pliers, or vises should not be used to alter this angle as they may convert the absolute circle of the reamed ring into a slight ellipse and thereafter it will not be possible to attach the ring to the tapered nail head.

Seven cases of nonunion among 120 subtrochanteric osteotomies are reported and summarized according to Table I. Three cases were treated by bone grafting. The pelvis is raised 6 inches from the operating table with sand bags. At least half of the iliac crest and adjacent ilium should be removed to obtain a sufficient amount of bone for packing the ununited bone area. The site of nonunion is approached by an incision that is somewhat more anterior than the usual lateral one. After the bone is exposed by cutting through the tensor fascia femoris and vastus lateralis muscles, a curved lever is placed medial to the femoral shaft and just below the base of the calcar femorale in the region of the lesser trochanter. Thereby the nonunion area is seen from the front. A ½ inch gouge is used to cut a gutter in the bone proximal and distal to the ununited area and this gutter should be as large as possible. The gouge is driven deeply into both fragments so that bleeding cancellous bone is exposed. The fresh bone obtained from the ilium is chopped up bone pieces no larger than maize. The chopped up bone is hammered into the medullary cavities of both fragments of the nonunited bone with the blunt and round head of a chisel until it forms a paste. After that the bone is packed in front and to the lateral side. Finally any respectable looking bone that had been cut out of the ununited area for providing the gutter is chopped up into chips about the size of wheat grains and inserted. When the wound is closed a bulge should be evident on the surface, indicating that a large mass of bone grafting material lies underneath. Immobilization is done by means of plaster spica or with the sling and traction. All 3 patients operated upon obtained sound osseous union.

The method was also used successfully in the treatment of a patient with nonunion following a fracture of the upper femoral shaft a trochanteric fracture

TABLE L—ANALYSIS OF SEVEN PATIENTS WITH NONUNION OUT OF ONE HUNDRED AND TWENTY SUBTROCHANTERIC OSTEOTOMIES

No.	Reason for Osteotomy	Age	Type	Post-operative Splinting	Treatment of Nonunion by Bone Grafting	Splinting after Bone Grafting	Result of Bone Grafting
	Osteoarthritis	63	Loruss Mc Murray 3/10/40	Slit and traction	None	—	—
	Osteoarthritis	1	Schana 12/12/43	Large spica	None	—	—
3	Osteoarthritis	33	Schana 4/11/43	Slit and traction	10/3/43	Large spica	Osteous union
4	Nonunion of fractured neck femur	40	Loruss Mc Murray 4/1/44	Slit and traction	None	—	—
5	Nonunion united fractured neck femur	51	Loruss Mc Murray 1/11/43	Large spica	None	—	—
6	Osteoarthritis	5	Loruss Mc Murray 7/1/43	Large spica	20/7/44	Slit and traction	Osteous union
7	Congenital dislocation of hip	33	Schana 2/2/43	Slit and traction	10/4/44	Large spica	Osteous union

() Ninety patients were immobilized by slit and traction, and 10 in large plaster spica. () There were 3 patients with nonunion and 4 of these had been immobilized by slit and traction and 1 by plaster spica. (3) Three of the 7 patients with nonunion were operated upon by bone grafting, and osteous union resulted.

In the presence of infection an advantage of this type of bone graft is claimed over the tibial twin saw bar of bone because the entire graft is not prone to be lost. Case 6 had a sinus which could not be cleared up. It was excised at the operation and the spongy bone graft was employed. Infection super-vened, but osteous union resulted after 6 months. When spongy bone graft for nonunion is combined with nailing and plating the nail and plate are attached first. The front aspect of the femur is guttered at the fracture site and not on the lateral aspect. A complete freeing of the two ununited ends is unnecessary. It takes too long and is harmful because it results in a disturbance of the blood supply.

Internal fixation of the osteotomized fragments after subtrochanteric osteotomy by nailing and plating eliminates external splinting and the patient may be ambulant or at least free to move around in bed. Before the operation, the exact site, line, and angle of the osteotomy must be planned because of the bends and angles that must be made in the plate to conform to the osteotomy. These details are worked out with paper models made from tracings of the x-rays. The plate is bent by the surgical

maker to the shape required because the steel must be heated for bending. The plating of a Loruss McMurray osteotomy is fairly easy if the plate is bent beforehand and the osteotomy is performed to plan, but the Schana operation is more difficult unless the upper fragment can be hooked down into the adducted position. If it cannot, then the leg must be fully abducted below the site of osteotomy which will make the application of the plate rather difficult.

Primary subtrochanteric osteotomy has been substituted by some surgeons for nailing of intra capsular fractures of the femoral neck to eliminate nonunion or traumatic arthritis because it is the method of treating these complications should they occur. The author suggests combining nailing and plating with primary subtrochanteric osteotomy if the fracture is more than 3 weeks old, the bone is comminuted, or the patient is a young manual laborer. No cases utilizing this form of treatment are reported.

This article is well illustrated with diagrams and x rays. A short bibliography is appended.

CHARLES A. WALKER, M.D.

SURGERY OF THE BLOOD AND LYMPH SYSTEMS

BLOOD VESSELS

Ross, J. P.: The Surgery of Arterial Disease and Injury *Brit. M. J.*, 1946 1: 1

Vasospastic phenomena are seen in a variety of conditions but true Raynaud's disease is a clinical entity. It is characterized by color changes in the digits produced by cold and occurring in attacks which show a rapid onset and recovery, the extremities are affected symmetrically. The peripheral pulses are preserved, and if there is any loss of tissue it is never more than a shallow ulceration close to the fingertips. True gangrene is extremely rare. The condition is almost exclusively limited to females, is not commonly excited by emotion and is not usually associated with excessive sweating. The author agrees with Lewis that it is due to abnormal sensitivity to local cooling of the small arteries.

In an attack the lumen of the digital arteries is almost completely obliterated. The value of sympathetic denervation is that the lumen of the vessels is permanently increased so that a cold stimulus while reducing it greatly does not arrest the circulation completely. Since sympathectomy should be complete for satisfactory results the author favors the posterior approach of Southwick and White for the upper thoracic chain. With the anterior approach of Telford there is greater danger of sparing anatomically abnormal filaments. For the lower extremity removal of the second, third and fourth lumbar ganglia is the usual procedure.

While there are many different causes of obliterative arteritis it is the level of the block in the arterial tree, not the cause, which determines the clinical picture and the value of sympathectomy in its treatment. Three clinical groups may be recognized. In one, a main vessel, such as the femoral or popliteal artery is thrombosed and the presenting symptom is intermittent claudication in the calf muscles. The nutrition of the skin of the foot remains good since an adequate collateral circulation keeps the distal vessels supplied. If the level of the block is low enough to involve the sural arteries which supply the gastrocnemii sympathectomy is of little value for claudication. However if the block is more proximal sympathectomy will provide a considerable increase in the blood flow to the calf. For this reason it is important to palpate the femoral and popliteal pulses as well as those in the ankle.

Some information about the probable effect of sympathetic denervation may be obtained by temporary block of the sympathetic trunk. A good response is an argument in favor of operation. On the other hand a poor response is not sufficient to deny the patient possible relief by sympathectomy since the postoperative improvement is gradual.

In the second clinical group the distal arteries are principally affected and the characteristic mani-

festations are rest pain and nutritional changes in the skin of the foot. The pulse in the main vessels may be present even at the ankle but there is an abrupt drop in the surface temperature at the level of the arterial obstruction. Sympathectomy in this group may often abolish the intense pain and permit successful local amputation of the toes if gangrene has already been established.

In the third group there is widespread narrowing of the lumen throughout the arterial tree. Sympathectomy is generally useless and amputation above the knee becomes necessary.

Fresh lacerations of the arteries should be repaired when possible, but contusions should be treated by excision of the contused segment and ligation of the companion vein. When an arteriovenous fistula follows vascular injury quadruple ligation and excision is the usual operative procedure. Twice in cases of popliteal aneurysmal varix the vein was ligated above and below the fistula so that the latter could be isolated and ligated like an arterial branch. The main artery was preserved. These patients suffered from symptoms of venous obstruction afterward. Consequently, in 2 other cases the artery was ligated above and below the fistula but the vein was left intact; the results were most satisfactory in these 2 patients. Because of the abundant collateral circulation associated with arteriovenous fistulas it is advantageous to preserve the vein when it is feasible to do so.

THOMAS B. MARSHALL, M.D.

BLOOD TRANSFUSION

Iokhveda, B. I.: Intracardiac Blood Transfusion *Amer. Rev. Series M.* 1945 212 216

The author reports 3 cases in which a physiological solution of sodium chloride, glucose, and blood were used for restarting the intracardiac blood flow.

In the first case the transfusion of blood through a needle inserted into the right ventricle corrected the apparent or clinical death and restored consciousness. Severe myocardial damage was probably responsible for the irreversible death that occurred 3½ hours later. It should be emphasized that in spite of the marked flabbiness of the myocardium the needle which was present in the heart for about 15 minutes while the heart was contracting had left only a minute puncture.

In the second case the cause of collapse and clinical death may be attributed to the profuse hemorrhage and to the rapid blood loss. A reflex shock occurred the volume of the circulating blood decreasing even more and the flow of blood to the heart diminishing greatly. Application of massage to the heart externally and the intracardiac injection of epinephrine might be insufficient in such cases since the cause of death is not failure of the myo-

cardium but inadequacy of the blood supply to it. The heart even when revived, will continue to work in vacuum and after a few seconds or minutes will stop again. Therefore, the author decided to adopt a more physiological approach by increasing the contents of the cavities. It is known that an increase in the contents, although not maximal is an adequate impulse to start contraction, as long as the heart is capable of responding to stimulation.

In the second case injection of blood and salt solution into the left ventricle rather than the right was indicated for a definite reason. Insufficient contracting force of the recently revived heart and the pressure behind the injected solution would have been insufficient to overcome the resistance provided by the capillary network in the lungs and only insignificant amounts would have reached the left side of the heart. By injecting these solutions directly into the left ventricle even the first and comparatively weak contractions of the heart re-established the blood supply to the vitally important brain centers and thus provided an antishock effect. In addition the increased volume output of the left ventricle independently improved the coronary blood flow.

When blood and other liquids are to be transfused into the right chamber the needle should be inserted into the lower part of the fourth left intercostal space one finger's breadth from the left margin of the sternum. This site will prevent injury to the intercostal neurovascular bundle and the internal mammary artery. The left ventricle will be entered when the needle is inserted in the same intercostal space and from 2.5 to 3 cm. to the left of the left margin of the sternum. *Joaquin Garras, M.D.*

De Weerd, W.: The Influence of Sex in Transfusion Reactions (Influence du sexe sur les réactions transfusionnelles). *Rev. belge de méd.* 945: 6, 1934.

Attention is directed to the role of the sex of the donor and of the recipient in the incidence of transfusion reactions. De Montla and Delhaye in 1937 found transfusion reactions in 8.7 per cent of female to female transfusions, in 8.3 per cent of male to female, in 3.9 per cent of female to male, and in 3.5 per cent of male to male. Hustin and Remy in 1942 studied 864 transfusions, and found transfusion reactions in 17.3 per cent of female to female transfusions, in 9.1 per cent of male to female, in 6.3 per cent of female to male, and in 5.3 per cent of male to male.

The author has compiled data on 666 transfusions given by the Belgian Red Cross in 1933 and has grouped them according to the sex of the donor and the recipient as follows:

	Transfusions	Reactions	Percentage
Female to female	88	28	3.2
Male to female	5	35	3
Female to male	90	43	
Male to male	37	47	9.8
Total	666	5	8

When grouped as to transfusion indications (neoplasms, infections, anemias) more reactions occurred in the patients who had primary blood dyscrasias.

The author believes that more research is necessary to determine the significance of the sex of the donor and of the recipient in transfusion reactions.

C. Farnsworth Ketter, M.D.

SURGICAL TECHNIQUE

OPERATIVE SURGERY AND TECHNIQUE POSTOPERATIVE TREATMENT

Croce, E. J. Schullinger R. N. and Shearer T. P.
The Operative Treatment of Decubitus Ulcer
Ann Surg., 1946 123 53

The authors present a method of primary closure of decubitus ulcers in young paraplegic casualties. Given the same back care postoperatively as the paraplegic without bed sores, the results seem to be quite as satisfactory as in patients with unbroken normal skin. The method seems to be applicable to the largest sacral ulcers. With rare exception, the results may be obtained by a single stage procedure. Careful pre-operative preparation and evaluation are just as important as is the technique of the operation itself.

The operation is performed without anesthesia. Complete excision of the ulcer including the peripheral scar tissue and the base is essential. Curvilinear incisions are made on each side of the defect and flaps are raised sufficiently to close the excised area. This is done by rotating the flaps on each side toward each other. Fine nonabsorbable sutures are used. Postoperatively pressure dressings are applied. Penicillin and sulfadiazine are administered when indicated.
BRYJAN GOLDMAN, M.D.

ANTISEPTIC SURGERY TREATMENT OF WOUNDS AND INFECTIONS

Dunroch, D. S.: Chemoprophylaxis. *J Am M Ass* 1946 130 124

In November and December of 1944 a controlled program of chemoprophylaxis against hemolytic streptococcus infections which were then of epidemic proportions was employed in three small naval training schools.

In the month of November significantly fewer streptococcal infections occurred in the groups receiving sulfadiazine prophylactic treatment (in daily doses of 1 gm.) than in the control groups. During this period sulfadiazine resistant Group A beta hemolytic streptococci were absent in one school and present only in small numbers in the other two schools. In December however with new trainees there was a progressive failure to prevent streptococcal infections in the treated group. The failure was related to the increasing prevalence of strains of Group A hemolytic streptococci which showed resistance to sulfadiazine in vitro.

WALTER H. NADLER, M.D.

Ackman, D. and Smith F. The Role of Chemotherapy in Wounds and Surgical Infections.
J Am Surg 1946 123 70

For the past 2 years the authors have been jointly engaged in a study of the effect of bacteriostatics in fresh trauma and pre-existing infections for the

National Research Council of Canada. The object of this investigation has been to determine as far as possible the practical value of bacteriostatics used topically or systemically and both prophylactically and therapeutically in fresh trauma and pre-existing infections. The work has been done in civilian hospitals and the laboratories of McGill University. A uniform surgical technique was adapted to the individual case so that the chief variables were the type of bacteriostatic and method of application.

The following points summarize the authors' convictions.

The nature, age and extent of any injury or infection profoundly modify the value of any anti-biotic substance.

Adequate surgery is more essential in the treatment of trauma than are chemotherapeutic substances.

The mere presence of bacteria in a wound is by no means synonymous with infection.

Bacteria tend to persist in a healing wound up to the time of complete and final epithelization without clinical signs of infection.

Pyogenic streptococci regularly disappear from wounds and pre-existing infections treated with sulfonamides or penicillin. Most other wound pathogens, notably the staphylococcus pyogenes, bacillus proteus vulgaris, pseudomonas pyocyanea, and clostridium welchii, persist in the presence of chemotherapy without necessarily producing clinical infection.

Bacteria in wounds were a far greater hazard in presulfonamide days than at present despite our inability to sterilize a wound completely.

Topically applied penicillin has not proved as effective an agent as sulfathiazole probably because of its rapid disappearance which makes frequent exposure of the wound necessary. Its routine systematic use in a large ward with normal personnel is much more burdensome than that of the more convenient sulfonamides.

It seems certain that bacteriostatics keep the contaminated wound from becoming an infected wound. Thus they probably do by prolonging the important lag period restraining free bacterial multiplication during this time and allowing elaboration of the natural barrier to microbial invasion.

All this is facilitated by immobilization and occlusive compression dressings which are changed infrequently.

Hypersensitivity reaction from topically applied sulfonamides is a highly controversial issue. The authors have seen such little evidence of it with infrequent dressings that they consider the risk entirely unimportant.

There is no convincing evidence that the bacteriostatics which have been used significantly influence

the pseudomonas pyocyanea or bacillus proteus vulgaris in a wound. This remains one of the outstanding unsolved problems. Both the unreserved condemnation of bacteriostatics and their endorsement as "miracle drugs" are the results of completely uncritical judgment. The truth as usual, lies somewhere between these two extremes. As far as trauma is concerned the most efficient of the bacteriostatics is, at best, only an adjunct to adequate surgery.

In chronic surgical infections surgery and amputation are interdependent. In acute spreading infections, chemotherapy is the immediate necessity.

BENJAMIN GOLZMAN, M.D.

Meleney, F. L., Johnson, B. A., Polsky, E. J., and Colonna, F. The Treatment of Mixed Infections with Penicillin. *J. Am. Med. Ass.* 946 30

In the treatment of surgical infections with penicillin it is of the utmost importance to have a complete picture of the bacterial flora of such infections and to know whether the organisms present are susceptible, indifferent, or antagonistic to penicillin. Attempts should be made to eliminate aerobic gram negative, nonsporeforming bacteria, which have a destructive action, before susceptible species have developed resistance to penicillin.

p-chlorophenol is the most effective antibacterial agent against gram negative organisms, of the presently available antiseptics so far tested. In a concentration consistent with safe clinical application p-chlorophenol was bacteriostatic and bacteriocidal for all the gram negative organisms tested whereas o-aminocidine hydrochloride and 5 nitro 2 furaldehyde semicarbazones were not effective against the pseudomonas pyocyanea.

The individual strain susceptibility of the gram negative organisms isolated from any given infection should be tested for the inhibitory action of para-chlorophenol, o-aminocidine 5 nitro 2 furaldehyde semicarbazone streptomycin and streptomycin, since the sensitivity of different strains within the same species as well as the sensitivity of different species varies greatly. All of these agents are compatible with penicillin and may be combined for local application to infected wounds. They may be incorporated in a carbonyl propylene glycol base for topical application and prolonged action in wounds.

W. T. H. NADLER, M.D.

Lescock, A.: Penicillin for Chronic Undermining Ulceration. *Bull. M. J.* 945 765

The case reported here is that of a 32 year old soldier who developed a large abscess in the left arm following an injection of T. A. B. vaccine. Despite free incision and drainage abscess pockets occurred and had to be incised. Undermining of the edges took place with the typical zones about the edges described by Meleney. The edges were excised and the sinuses opened to give a large flat wound. Plaster immobilization for one month resulted in a grad-

ual extension of the ulcer so that the involved area covered most of the posterior surface of the arm. Various bacteriostatics were unavailing. Zinc peroxide was not obtainable. An anaerobic hemolytic streptococcus staphylococcus aureus and pseudomonas pyocyanea were isolated from the wound on culture.

Seven and one-half months after the initial injection the lesion was treated with local penicillin (100 units per cubic centimeter) enough to keep the dressings wet. After 48 hours the penicillin sensitive organisms had disappeared and in 5 days improvement was marked. The pyocyanea diminished under 1 per cent acetic acid dressings. Epithelialization covered more than half of the area and Thiersch grafts were applied to the remainder.

The literature is discussed and the lesion is demonstrated from postoperative cutaneous gangrene. The author believes that penicillin applied locally may be more effective than zinc peroxide and may replace it.

THOMAS C. DOUGLAS, M.D.

Wu-Chang Chiu: Miscellaneous Pharmacologic Actions of Citrinin. *J. Lab. Clin. M.* 946 317

Citrinin is the antibiotic substance produced by the molds, penicillium citrinum, aspergillus terreus, and aspergillus candidus. It is also found in a flowering plant, the crotalaria crispata. It is an organic acid but has not been synthesized. It is stable, and can be antiseptized at 15 pounds of pressure for 30 minutes without loss of antibiotic power. It has a fairly high antibiotic action on most gram positive bacteria but, unfortunately, it is rather toxic for higher animals. It has been reported as useful as though weaker than penicillin in the local treatment of sore throat of the common cold, and of abscesses. Nothing, however, has hitherto been reported about its local effects, possible injuriousness to the mucous membranes and skin, and its systemic effects and absorption from various regions especially after local applications.

Proposed concentrations of citrinin sodium in sprays, lotions and ointments for local application to the mucous membranes and the skin were not found to be demonstrably irritating or injurious, however the slight or moderate irritation which they produced was not objectionable as indicated by tests in animals and human beings. Concentrations higher than those proposed caused definite protoplasmic irritation or injury but this was temporary and readily reversible.

Systemic absorption of citrinin, in animals receiving high concentrations and doses by instillation into the nose or mouth is practically negligible. Blood concentrations of from 1:4,000 to 1:30,000 citrinin were demonstrable after the introduction of high doses of citrinin into the ligated esophagus and stomach and all portions of the intestine of rats and also after intramuscular injection.

Rapid intravenous injections of citrinin in doses of from 1 to 100 mgm. per kilogram caused immediate, though temporary depressor effects, which

increased with the dosage this was due presumably partly to direct cardiac depression, and partly to peripheral vasodilatation. The highest doses used could produce dangerous sustained depression. Slow intravenous injections of citrinin however had no such effect. A reversal of the depressor to pressor action occurred in atropinized animals.

The average bacteriostatic concentrations of citrinin in broth were 1:16,000 for the staphylococcus aureus, and 1:40,000 for the streptococcus hemolyticus. The antibacterial action was unaffected by human serum, increased by fresh human urine, and decreased by heated urine. Experimental staphylococcal infection in mice was not prevented with high doses (one-half the toxic) given intraperitoneally.

SAMUEL KAHN M.D.

Olsen, C. T.: The Use of Tantalum Oxide, Type 400, in the Treatment of Wounds. *Indust M* 1945 14 949.

This article is a preliminary report of the author's experience with the use of tantalum oxide type 400. During the war, tantalum for surgical purposes was in great demand in the form of sheet, foil and wire with probably its most successful surgical application in cranioleptasty. Of all the metallic implants it has the highest resistance to corrosion in vitro and in vivo. Furthermore body reactions to it are strictly minimal.

Discussion with metallurgists revealed that the healing properties of the tantalum metal must be due to the oxide coating of the tantalum which is always present. Therefore tantalum oxide powder was prepared in such a way that it was free of all fluorides and alkaline substances. As a dusting powder it is extremely soothing to areas of the skin which have been chafed or irritated. It is easily sterilized by heating at a temperature of 310 degrees F in a dry oven and repeated sterilizations do not affect it. It is a material which can be kept easily at hand and used in a perforated top glass bottle, a powder blower or sometimes by dumping it out of an open container and spreading with a sterile applicator.

Indications for use of tantalum oxide include avulsed finger nails, chemical burns, diaper rashes, weeping lesions. It can also be used for surgeon's gloves, for intravaginal application and as a packing for sockets of freshly extracted teeth.

The danger of secondary contamination due to redressing is practically eliminated by its use. Relief of pain is attributed to the tight sealing off which the tantalum oxide crust produces.

STEPHEN A. ZIEGLER M.D.

Burke, C. W., Bronstein, B., Hirschfeld, J. W., and Pilling, M. A.: In Vitro Action of Streptomycin on Bacteria. *J. Am. M. Ass.* 1946, 30 64.

Streptomycin has been shown to be effective against a variety of gram positive and gram negative bacteria both in vivo and in vitro. Before it can be used rationally in treating disease an evaluation of

dose intervals and sizes and determination of the bacterial susceptibility must be carried out. There are definite in vitro differences in bacterial sensitivity to streptomycin and within a given species strains may vary from extreme susceptibility to high resistance. The blood concentration of streptomycin reaches a peak soon after parenteral injection and then falls gradually to zero. To use the drug rationally one must determine if a high enough concentration is being maintained with reference to the sensitivity of the particular strain of bacteria isolated. Frequently a smaller dose or longer interval between doses may be sufficient to maintain a blood level more than ample to inhibit the in vitro growth of the invading organism. On the other hand these studies may indicate the need for larger doses given at more frequent intervals.

This study had a threefold purpose (1) to determine the sensitivities of several species of bacteria to streptomycin (2) to correlate these sensitivities with the serum concentration of streptomycin that may be maintained in patients and (3) to determine whether the bacteria investigated developed a resistance to streptomycin in vivo.

Bacteria were isolated from 38 patients with various infections such as peritonitis, empyema, septicemia, infected wounds and burns, urinary tract infections and pelvic abscesses. The urine or pus was cultured before and at intervals during treatment with streptomycin. Each organism present was isolated in pure culture but complete identification of all the bacteria was not made. The following organisms were identified: *Escherichia coli*, *Aerobacter aerogenes*, *Pseudomonas aeruginosa*, alpha and beta hemolytic streptococci and the staphylococcus. After the organisms were obtained in pure culture they were screened for their sensitivity to streptomycin following which their sensitivity over a narrower range was determined. The action of streptomycin on anaerobic organisms was not determined.

The authors describe their method of screening to determine the approximate sensitivity to streptomycin, and a method to determine sensitivity values within narrower ranges than those possible with the twofold serial dilution method.

It has been found that the parenteral administration of 500,000 S units of streptomycin will maintain a serum concentration of from 10 to 15 units until the end of 4 hours. Theoretically, then all bacteria reported in this article with a sensitivity of 8 units or less would be inhibited over a period of at least 4 hours by a parenteral injection of 500,000 S units of streptomycin.

Two hundred and twelve strains of bacteria were tested for susceptibility to streptomycin. The majority of the strains of *Escherichia coli*, *Proteus vulgaris*, *Aerobacter aerogenes*, staphylococcus, and streptococcus were susceptible in vitro to the blood concentration of streptomycin that can be maintained in the average patient over a 4 hour period when he has been given 500,000 S unit dosages of

from 5 to 8 S units per cubic centimeter of blood. The majority of strains of *Pseudomonas aeruginosa* investigated were found to be very resistant to streptomycin. Resistant strains of a given bacterium were isolated from patients subsequent to the isolation of sensitive strains. The assumption is that resistant strains developed from the sensitive strains. Diphtheroids were found to be either very sensitive or highly resistant to streptomycin.

ROBERT R. BIGELOW M.D.

ANESTHESIA

Wilson, C. H.: *Military Aspects of Early Analgesia and Anesthesia Current Res 1946, 5*

The instructional approach to the military aspects of early analgesia and anesthesia at the Medical Field Service School had to be basic enough to include all of the important phases of the subject, and at the same time show the well trained anesthetist the problems he would encounter in forward anesthesia. This article discusses the overall problems involving analgesia and anesthesia in the combat areas.

The basic factor which determined the analgesic or anesthetic agents used was their availability. The drugs available to relieve pain were eugenol, acetyl salicylic acid, codeine sulfate, morphine sulfate and morphine tartrate. The two narcotics available were phenobarbital and sodium amylal. The morphine syrette proved invaluable in the combat zone. One-half grain of morphine tartrate was dissolved in 1½ c.c. of fluid placed in a tube with a rubber diaphragm and needle and kept sterile with a celluloid shield. This simple morphine tube simplified injections in the combat area.

Morphine was contraindicated in head injuries, lung irritation from war gases, heat cramps, conditions resulting in anoxia and respiration depression and conditions in which the symptoms had to be observed to determine the necessity of operative intervention. Stress was laid upon the use of morphine to relieve pain.

The anesthesia used forward of the evacuation hospitals had to be simple, safe, portable, and rapid in action control. Procaine hydrochloride was the agent of choice for nerve block. Inhalation agents were limited to ether and chloroform was used as a reserve agent. The instructions concerning the use of intravenous anesthesia had two purposes. First, to keep medical officers informed and up-to-date concerning the official opinion of the Army Medical Department on the use of pentothal sodium. Second, to give basic facts about pentothal sodium to those physicians who had little or no knowledge of the drug. Care must be taken not to inject pentothal into an artery. The dangers of this drug were enumerated. It was considered hazardous in cases of morphine overdosage, shock, infection of the neck, cervical or sublingual infections, in operations with great blood loss and those involving the airways. The

methods of resuscitation were enumerated. The use of analeptic drugs was discouraged.

Spinal anesthesia had little value in the advanced medical units during active campaigning but was used in the clearing stations. Whenever available, inhalation anesthesia with positive pressure apparatus was preferred for serious chest injuries. General inhalation anesthesia was slow to give adequate relaxation for intra-abdominal surgery and pentothal sodium was used more frequently than any other anesthetic agent by both the British and Americans in the many forward installations.

MARY KAY M.D.

Beecher H. K.: *Pain in Men Wounded in Battle. Ann Surg 1946, 3: 96.*

Two hundred and twenty-five freshly wounded men in the combat zone were studied for this report.

Attempts were made to correlate the pain with the extensiveness of the wound and to question the routine employment of morphine in these wounded patients. Consecutive cases were observed with no selection other than that they had one of five kinds of wounds chosen as representative: extensive peripheral soft tissue injury, compound fracture of a long bone, a penetrated head, a penetrated chest, and a penetrated abdomen. The patients chosen were clear mentally and were not in shock at the time of questioning.

The findings were as follows: 32 per cent had no pain, 35.6 per cent had slight pain, 18.6 per cent had moderate pain, and 13.7 per cent had severe pain.

Patients with penetrated abdomens had by far the most pain, possibly because of the spilling of blood and intestinal contents into the peritoneal cavity. Of all the patients considered, only one-fourth, on direct questioning, stated that their pain was severe enough to require pain relief therapy.

Data were presented to show that morphine was often administered by rote and not according to the patient's needs. When morphine was necessary, the intravenous method was considered optimal to avoid the possibility of long delayed action during periods of peripheral circulation shock. Morphine should not be used in nervous or manic or hysterical states to allay fear or to promote sleep for these purposes. Small doses of barbiturates have been adequate. Morphine should not be given in shock, unless pain is present in hypothyroidism, in the presence of dysfunction of the liver or when even a mild degree of anoxia exists.

Delayed morphine poisoning has occurred in battle casualties when the peripheral circulation was sluggish or inactive as it might be in patients who are chilled and have low blood pressure.

The treatment of morphine poisoning includes the placing of a tourniquet, intermittently loosened proximal to the site of the injection, the prevention of anoxia by oxygen administration and artificial respiration, and the intravenous administration of atropine (gr 1/160) or ephedrine (gr 1/4) as a central stimulant. Hypertonic glucose may be

given intravenously to aid diuresis. Body heat should be conserved if necessary. Regional nerve block proper splinting and bandaging are of use in allaying pain. Wounded men need sedatives of the barbiturate type as well as barbitals at times and small doses of both types of agents will accomplish what large doses of either alone will fail to do.

The man in shock complains far less frequently of the wound pain than he does of the great distress caused by thirst.

Donatelli L.: Mephedine as a Pharmacologic Product for Preparing the Patient for Anesthesia (La medicina come farmaco de preparazione alla anestesia). *Polidin* (as *ca*) 1945 53: 103

Mephedine is a new synthetic alkaloid derived from piperidine (ethyl-ester of the hydrochloride of 1-carboxylic acid 4-methyl-4-phenyl-piperidine) was subjected to a series of studies by the author at the Institute of Pharmacology and Toxicology of the University of Florence and Toxicology of the University of Florence. These studies were calculated to determine its qualifications as a so-called preanesthetic preparation that is a preparation to render the induction of general anesthesia easier and less harmful to the patient. These studies might be divided into four groups or propositions in the first the action of mephedine on somatic and psychic sensitivity was investigated. In the second any synergistic effects between mephedine and general and local anesthetic agents were considered. In the third attempts were made to clarify any influence of mephedine on the more important and more common nervous reflex systems capable of suffering operative or anesthetic result with reflex injury to the more vital vegetative functions and finally in the fourth attention was directed to any injurious secondary actions provoked by mephedine.

Group 1. The technique for this study in determining depression of the somatic sensitivity was that of Hillner (*Dieck and Ilck* 1939 p 731) using guinea pigs and the degree of the drug effect was graded according to the degree of the drug effect was stimuli (pinching of the animals' response to painful stimuli) (pinching of the ear lobe). The subcutaneous injections of 1 per cent mephedine in a dosage of 15 mgm per kilogram were found to have little effect on the pain response whereas with dosages of from 20 to 50 mgm the analgesic action became progressively more intense with complete analgesia at the highest dosage. The effect became maximum within 10 minutes and lasted for from 60 to 120 minutes. Since Mancini has determined the minimal lethal dose for guinea pigs to be 150 mgm per kilogram the great margin of safety of mephedine deserves notice.

For measuring psychic depression (preoperative anxiety) of this drug mice (*mus musculus*) were used after being accustomed to finding their way to food through a specially constructed labyrinth. After several days of accustoming the animals they would be given subcutaneous injections of

from 25 to 50 mgm per kilogram of mephedine and the subsequent time for traversing the labyrinth was observed. Again it was found that 25 minutes after 25 mgm had been injected and more pronouncedly when 50 mgm were used the animal had lost completely his ability to traverse the labyrinth this effect disappeared more or less completely after 85 minutes. Some of the animals especially those given 50 mgm became permanently lost in the labyrinth.

Group 2. For the study of the potentiating effects of mephedine a general anesthetic preparation was selected and also a peripheral or local agent. The general anesthetic was the sodium salt of 5 (alpha-methyl-beta-cyclohexyl) 1-methyl barbituric acid (evipal) and the local anesthetic was procaine (procaine hydrochloride acid). A third (general) anesthetic prepared was ether. A third (general) olive oil for subcutaneous injection. This animal employed was the rat (*mus rattus*). This animal was considered completely narcotized when it had fallen on its side its head had fallen loosely the body was immobile and there was no reaction to painful stimuli.

In this experiment the animals were divided into groups: a control group receiving subcutaneously from 1 up to 10 c.c. of the ether (in 1 c.c. increases) in oil the test group receiving 50 mgm per kilogram of mephedine which by itself always left the animal normal or perhaps even a trifle excited—this was followed 30 minutes later by the amounts of ether in oil specified for the control group. It was found that the rats treated previously by mephedine fell under narcosis much sooner than the corresponding control and slept much longer and more deeply. For instance with the dosage of 7 c.c. per kilogram of ether in oil the control slept for 3 minutes while the animal receiving the preliminary treatment with mephedine slept deeply for 87 minutes. While 5 c.c. of ether in oil were not sufficient to bring the animal under narcosis but produced definite narcosis in pre-treated subjects. The potentiating effect of mephedine on the anesthetizing power of ether in oil is so great as to reduce to one half or even to one third the amount of ether necessary.

In the corresponding studies on mephedine and evipal the conditions were generally the same except that guinea pigs (*cavia colaya*) were the experimental animals used. Evipal in a 1 per cent solution was injected intraperitoneally in every animal subcutaneously from 25 to 50 mgm being used per kilogram of body weight of the guinea pig and the criteria of narcosis remaining the same for this animal as for the rat in the previous study.

With the larger of the 2 dosages of mephedine cited (50 mgm per kilogram) torpor and analgesia would be produced but never narcosis while with the smaller dosage (25 mgm per kilogram) the effect was rather an excitation of the animal. Likewise with the evipal alone a 1 minute narcosis was required to induce a narcosis of 34 minutes while 50 mgm lengthened the narcotic period to 70

minutes. With the mephedine preparation, however the narcosis appeared sooner lasted much longer and was much deeper with more complete muscular relaxation. In fact, if 30 mgm. per kilogram of mephedine were administered to the subject previously, the 25 mgm. of evipal, which produced narcosis lasting for an average of 34 minutes resulted in narcosis lasting 73 minutes or more than twice as long and with the aid of mephedine 15 mgm. of evipal became sufficient to induce the narcotic state.

In the succeeding studies with evipal used intravenously on rabbits the same potentiation on the part of mephedine was observable.

In order to test any potentiative effect of mephedine on the local anesthetic power of procaine hydrochloric acid the corneal reflex of the guinea pig was used. This was induced by touching the cornea at second intervals with the Frey brush, from 2 to 10 such stimuli usually being sufficient. Procaine solutions in dilutions of 0.5 to 10 per thousand were instilled into the conjunctival sac and retained in contact for 2 or 3 minutes, the anesthetic action beginning at strengths of 0.5 per thousand. Mephedine given subcutaneously in doses of from 20 to 30 mgm. per kilogram and synchronously with the instillations of procaine induced corneal anesthesia, frequently intense even with the smaller dose of mephedine (20 mgm. per kilogram) which of itself does not induce any evidence of such loss of sensitivity and with the noneffective strength of procaine (0.7 per thousand solution). Similar effects were observed in subsequent experiments with rabbits as experimental animals, and there is little doubt left as to the potentiating power of mephedine on procaine hydrochloric acid with regard to its local anesthetic properties.

Group 3. To investigate the danger of damage or even death to the patient from reflex effects on the heart, respiration, or vomiting reflex, the rabbit was chosen for the experimental animal. It was tracheotomized and chloroform vapor was insufflated backward from the cephalad stump of the trachea through the pharyngeal and nasal passages and the resulting responsive effects on the heart action and respiration were recorded by kymographic tracings. The same technique and tracings were produced after the endovenous perfusion of 1 mgm. per kilogram of a solution of mephedine in such a manner that the animals received 33 mgm. per kilogram of this drug when the reflex characteristics of these tracings, before the injection of mephedine, had entirely disappeared. Therefore taking the reflex irritation of chloroform vapors on the nasopharyngeal area as typical of all induction irritation reflexes of the other anesthetics and such reflexes as typical of all the reflexes incident to general anesthesia which are dangerous to the life of the anesthetized. It seems evident that mephedine administered in advance of the inhalation anesthesia, is capable of depressing or even annulling all of the dangers arising from irritation of the upper respiratory tract.

Mephedine likewise seems to obviate the dangerous respiratory and cardiac reflexes due to rough

handling or pulling on a nerve during the operation. For this study the exposed sciatic nerve of the rabbit was stimulated electrically it being found that all evidence of such reflexes began to decrease with the perfusion intravenously (within a space of 7 minutes) of 7 mgm. per kilogram of mephedine, and that all trace of such reflexes disappeared with higher dosages.

Likewise in the case of the vagus reflexes, mephedine showed itself capable of suppressing the arrest of respiration and of the sudden hypertension and cardiac disturbances incident to stimulation of the central stump of the severed vagus nerve.

Identical results were induced in the nerve of Cyon of the rabbit, stimulation of which normally leads to such a sudden and severe bradycardia and fall of blood pressure the necessary dose of mephedine in this instance was 14 mgm. per kilogram.

Although mephedine does not entirely abolish the carotid sinus reflex it does attenuate such reflex and thus promises to obviate such incidents as arise during operations on the neck and floor of the mouth. These incidents are not always suppressed either by such anesthetic agents as evipal or by deep general inhalation anesthesia.

The author also investigated the reflexes due to pulling or other mishandling of pedicles and other forms of attachments of the organs. As a typical reflex he chose for study that produced by traction on the mesogastrium and suspensory ligaments of the stomach. This was accomplished by laparotomy tying the animal (rabbit) and attaching a forceps to the stomach then closing the abdomen, so that the stomach could be subjected to traction from the outside. Again the tracings showed that the consequent respiratory and cardiovascular reflexes could be abolished by the perfusion of 60 mgm. per kilogram of mephedine into the marginal vein of the rabbit within an hour's time.

Before concluding this section of his studies, the author reports some studies on mice. They had nothing to do with the suppression of reflex responses by mephedine but were practically related to them. They concerned the primary or induction excitation of the animal as produced by other types of anesthetic agents, of which he chose evipal as being typical. Six mice were injected endoperitoneally with 1 per cent solution of evipal, up to dosages of 20, 40, 60, 80, 100 and 200 mgm. per kilogram. Of these dosages, all except that of 20 mgm. produced violent excitation in the injected animal there were also clonic convulsive attacks followed by depression and ataxia. Forty milligrams produced convulsions and ataxia, but not narcosis and the animals recovered after about 30 minutes. 60 mgm. or more caused narcosis and death in from 45 to 100 minutes. 20 mgm. had no effect whatever. Six other mice, 30 minutes previously had received subcutaneous injections of 5 mgm. per kilogram (1 per cent solution) of mephedine, in these, 20 mgm. per kilogram of evipal induced narcosis without excitation within 10 minutes, which lasted several minutes. 40 mgm. or more produced death in narcosis without excitation.

Group 4. Mephedine in therapeutic doses exerts scarcely any or no action on the respiratory and cardiovascular systems but in large amounts it constantly brings about a lowering of the blood pressure and a reduction of the amplitude of cardiac contractions and of the respiratory frequency. These effects are however found with endovenous administration, but not with subcutaneous injection nor with very slow endovenous perfusion even in large doses. For instance with an endovenous perfusion of 60 mgm. of mephedine per kilogram in a rabbit accomplished within a space of 60 minutes the accompanying tracing did not show any substantial modification of the respiration however 10 minutes after perfusion of a rabbit with 60 mgm of mephedine per kilogram and per hour the tracing (revealing also the cardiac function) showed a lowering of the arterial blood pressure of about 30 mm of Hg and a diminution of the amplitude and frequency of respiration without any evidence of disturbance of the heart action. This however, tended soon to return to normal, so that at the end of 60 minutes (during which period 60 mgm per kilogram has been administered) all of the functions appeared to be perfectly normal.

In conclusion the author desires to call attention to the fact that mephedine exerts a spasmolytic action on all smooth muscle (vascular bronchial, and intestinal) which effect deserves the attention of the surgeon.

JOHN W BRECKMAN M.D

Allen F M Crossman L W, and Lyons, L V :
Intravenous Procaine Analgesia. *Current Res Anesth* 1946 25 1

The purpose of this work was to use intravenous procaine in the widest possible variety of painful conditions, the fundamental basis being that the great majority of pains are associated with local inflammation or edema. Thus, procaine diffusing through specially permeable capillaries may produce analgesia of the nerves in those tissues without important effects elsewhere in the body.

At first the original method as suggested by Lundy was adopted, with a 0.1 per cent procaine solution in physiological saline solution. The results of Lundy, Gordon, and McLachlin, and Bigelow and Harrison were confirmed. Subjective disturbances of over doses were dizziness, blurred speech, or mental confusion. The literature suggested epinephrine as the antidote for respiratory symptoms of intoxication and intravenous barbiturate for intoxication in the form of convulsions but the authors saw few of these complications. In the group of obstetric cases in which procaine was infused intravenously, this method created an optimistic impression that it might prove to be the ideal obstetric anesthesia and the fulfillment of the quest for the prevention of pain during childbirth. A barbiturate was always administered as preliminary medication. Case reports were given in detail illustrating the use of intravenous procaine in such conditions as nucleus pulposus gangrene, bed sore, and angina.

The authors modified the Lundy technique by increasing the quantities of infused fluid and procaine by lengthening the period of infusion, by using glucose solution when saline solution might conduce to harmful edema, and by extending the range of application of the tests to all kinds of painful conditions. The method was found to have definite though limited value and when hypersensitivity to procaine had been excluded by preliminary tests and when the administration was kept within the limits set by dizziness or other subjective symptoms there appeared to be no danger whatsoever.

The experience with obstetric operations was extended to ordinary surgical operations of which a case records were summarized as examples of the method. In a hip pinning 375 c.c. of salt solution containing 2.75 gm of procaine were used during the course of 1 1/4 hours and 4.25 gm of procaine were used for a cholecystectomy in the course of 1 1/4 hours. The first patient remained practically unconscious throughout with wide open staring eyes and a wild expression, but later on questioning he claimed that he could remember what was said and done during the operation but that he had no pain at any time. The second patient had the appearance of normal sleep with a peaceful facial expression and imperfect muscular relaxation. The method has the advantage of rapid and flexible control, absence of accompanying injury or after effects and a high degree of safety as far as can be judged to date. As soon as possible, collaborative studies will be published which will attempt to establish a more adequate basis for acceptance or rejection of the method.

The infusion in higher dosage has produced a clinically new form of general anesthesia by action upon the central nervous system. It is hoped that this method will prove valuable for various purposes, but there has not yet been sufficient experience to define accurately the uses, limitations or possible dangers.

MARY KARP M.D

Lobachev S V : Refrigeration Anesthesia in Surgery of the Extremities. *Current Res Anesth* 1946 25 22

Investigational work was done at the Sklifosovskii Institute of Moscow on the technique of refrigeration anesthesia, the history and bacterial flora of cooled tissues, and the relation of this anesthesia to shock. The material consisted of 100 cases 87 of which were traumatic injuries 4 of gangrene due to vascular diseases and 9 of septicemia. Refrigeration anesthesia was considered excellent in 75 per cent of the cases good (slight pain on handling the nerve trunks) in 22 per cent, and poor (addition of ether required) in 3 per cent. Postoperative complications occurred in 12 cases 4 developed wound infections. The mortality rate was 3 per cent, 2 patients succumbing within 24 hours to a high stage traumatic amputation of both thighs complicated by brain injury and a third pa-

tient dying from milary tuberculosis of the lungs months after the operation.

The tourniquet site selected was encased in ice for from 15 to 30 minutes, and then the tourniquet was applied. Soft elastic rubber was used for this purpose the width of the rubber making no difference. The extremity was lifted prior to the application of the tourniquet in order to drain away the blood. The limb was then placed on a leather sheet filled with ice or snow and this was covered with another thick layer of ice or snow extending to from 5 to 10 cm. above the tourniquet. It was found that the temperature of the deep structures at the site of the incision was between plus 5 and plus 10 degrees C when the anesthesia was sufficient for surgical intervention. More intensive cooling caused irreparable damage to the tissues, while higher temperature resulted in unsatisfactory anesthesia. Without a tourniquet the cooling was unequally distributed. The cooling time needed was from 90 to 120 minutes for the thigh, from 60 to 90 minutes for the leg and from 45 to 60 minutes for the arm and the forearm.

The temperature of the stump gradually returned to normal an hour after the tourniquet was released. After the stump was dressed it was covered with ice packs for 48 hours and the sutures were removed 12 or 13 days postoperatively as the healing was somewhat retarded because of the reduced metabolism of the cooled tissues.

It was found that pain sensibility of the limb was the first to disappear on cooling followed by loss of temperature sensation, and finally by loss of tactile senses. Histologically the tissues examined during refrigeration did not differ from those of normal controlled tissues.

Primary suppuration was rarely found in spite of the injuries contracted in the streets. The bacteriological studies showed that the growth of microorganisms was inhibited. The pulse was not altered even in serious cases but respirations were accelerated. The temperature remained normal in that part of the body not refrigerated. There was no increase of palor sweat cyanosis during the operation. The patient usually responded to stimuli more actively as soon as refrigeration was effected. Apathy and somnolence gradually disappeared.

The advantages were summarized as follows

1. No anesthetic drugs are introduced into the system.
2. There is a local reduction of temperature which counteracts the traumatic shock by numbing the tissues and especially the nerves.
3. The application of the tourniquet and the cooling of the limb retards the formation and absorption of toxins.
4. Toxemia is reduced and shock is controlled.
5. This method has special advantages in the aged and in patients who are seriously ill with septicemia.

MARY KARP M.D.

which then appears to be embedded in a spongy mass. Myositis ossificans may add further layers of calcium around the joint. Numerous loose bodies are frequently present, often arranged in clusters to give the so-called "bag of nuts" appearance. Although considerable swelling is usually present, fever and other signs of inflammation are absent. The lesion may therefore, progress unattended until multiple fractures in the adjacent bones and a dislocation cause complete mechanical disability.

A complicating pyarthrosis may make the differential diagnosis difficult. Ordinary degenerative arthritis may be distinguished from neurogenic joint lesions by the absence of subchondral cyst formation in the latter. The rapid progression, the severity of the lesions and if present a perforating ulcer of the foot supplement the diagnosis of tabetic arthropathy.

A spontaneous fracture or a fracture after slight trauma may be the first sign of tabes.

GERHART S. SCHWARTZ, M.D.

Bauer, G.: Observations on the Technique of Phlebography. *Acta rad. et Stockh.*, 945, 26-377.

The author who has conducted 500 phlebographies since 1938 reports his findings in 180 leg phlebograms of patients suspected of developing thrombosis of the leg veins. The purpose of these examinations was to make possible the early therapeutic administration of heparin or dicumarol, which indeed succeeded in preventing the spread of thrombo-

phlebitis to the thigh in all treated cases. The findings were as follows:

In 73 cases the failure of the deep veins to visualize was considered evidence of thrombosis. In 62 cases there was good or fair visualization of all the main veins. None of these patients developed signs or symptoms of thrombosis subsequently. Eighteen cases displayed sectional occlusion of a vein with dilatation of the preceding vessel segment. In 27 cases single or multiple filling defects were found. In 42 of the 45 cases comprising the latter two groups, good circumstantial or indirect evidence of thrombosis could be established.

From his findings the author draws the following conclusions:

1. The most reliable x-ray sign of thrombosis is nonvisualization of the deep veins. An apparent constriction of a visualized vein to a threadlike caliber represents sedimentation of the contrast material and is not significant. It occurs only if the leg is placed in the horizontal position, a position which, nevertheless is to be preferred to the vertical for various other reasons.

2. Another valuable sign is filling defects caused by nonocclusive space occupying thrombi in the veins. These might be confused with false filling defects which are located at ramification points of the vessels. They are caused by displacement of the contrast material by reflux of the fresh blood from a side vein into the visualized vessel and are smaller than the former.

Various techniques are discussed. The author recommends perabrodil or diodrast (35 or 50%) for contrast material. An acceptable substitute is a mixture of equal parts of Intron and physiological saline solution. It necessitates, however the flushing of the veins with from 10 to 20 c.c. of saline solution in patients who experience cramplike pains in the calf after the injection. Section of the lateral malleolar vein is preferred to percutaneous venipuncture. Two stereoscopic films are better than a single film but not as good as a single frontal and a single lateral film of the leg combined.

GERHART S. SCHWARTZ, M.D.



Fig. N. Visualization of the deep venous trunks in the middle third of the lower leg, due to thrombosis. Within days phlegmasia alba dolens occurred.

Lodge, T.: The Anatomy of the Blood Vessels of the Human Lung as Applied to Chest Radiology. *Brit. J. Radiol.* 946, 9.

The literature on the gross anatomy of human pulmonary arteries, veins, and bronchi is summarized with special stress on the topographical relationships of these structures and the part played by radiological methods in establishing them. The author then recounts his own findings in pulmonary bronchovascular relationships in the normal, which he plans to use later as a base for radiographic study of pulmonary vascular changes in response to disease or physiological stresses.

In this present study of the normal three methods were used: the production of celloidin models by the modified corrosion technique (Fig.) radiography of the lungs following injection of the vessels with

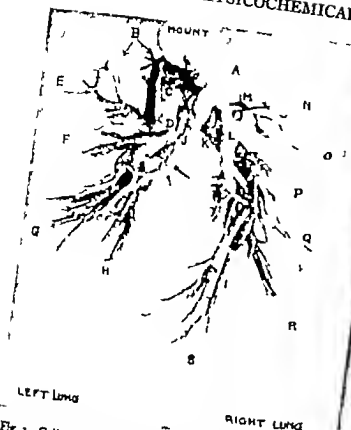


Fig. 1. Celloidin model of the bronchi and arteries of the two lungs as seen from the posterior aspect. The trachea and bronchi are lighter colored and the arterial system is dark. Key to figure: A, trachea; B, apical artery; C, pulmonary artery; D, left pulmonary artery; E, axillary artery; F, pectoral artery; G, axillary basal artery; H, lingular artery; I, right main bronchus; K, right pulmonary artery; J, left main bronchus; M, pectoral artery; N, apical artery; O, axillary artery; P, first posterior horizontal; Q, second posterior horizontal; R, axillary basal artery; S, posterior basal artery.

Fig. 2. Chest roentgenograph showing particularly clearly the distribution of the main arterial trunks in both lungs. The right lower lobe vein can be seen between the tenth and eleventh ribs, and in the left midaxone the long tapering trunk passing downward is the lingular artery. The roentgenograph also illustrates thinning of the vessels at the left base, where there is clinical evidence of emphysema. These vessels should be compared with those of the right base, which are much thicker.

barrum sulfate suspension and tomography in the living subject. The author then applied the kinwledge so gained in ascertaining which anatomical vessels could ordinarily be seen and with what frequency and variation, in the posteroanterior roentgenographs of 200 normal individuals.

He stresses the generally accepted facts that the linear shadows seen traversing the lung fields in normal roentgenographs are produced by blood filled arteries and veins and not by bronchi, and that the vascular distribution of the left lung is essentially homologous with that of the right, the lingular artery on the left substituting with considerable exactitude for the right middle lobe artery with the exception that the former is derived from the left upper lobe artery and the latter from the right intermediate artery.

In general, the author's findings in vessel bronchus relationships in the human being were similar to those of Miller in the lungs of pigs and dogs and followed Greineder's law namely that artery bronchus, and vein are found in that order proceed

ing anticlockwise in the right lung and in the same order but clockwise in the left. The whole pulmonary arterial system was seen to follow the branching and whereas the veins tended to lie distant from the bronchi in their interspaces and to cross the bronchi at an angle.

Some veins may be seen to cross the arteries at an angle of almost 90 degrees an observation useful in differentiating veins from arteries in the roentgenograph.

On attempting to apply the knowledge gained by these studies to the survey of the roentgenographs of 100 normal subjects the author found it possible to recognize and name the majority of the first and second order branches (Fig. 2). He calls attention to the fact that the shadows of the veins are in general, less dense and less clear cut, but wider than those of the corresponding arteries and to the observation that vessel shadows are either straight or gently curved but never tortuous or taut.

LILLIAN DONALDSON M.D.

Plahler G. E.: The Development of Roentgen Therapy during 50 Years. *Radiology*. 945, 45 505.

The author remarks on the almost immediate attempt on the part of physicians in all parts of the world to turn Roentgen's discovery of the x rays in December 1895 to therapeutic uses. The interest in fluoroscopic examinations with the new rays in the absence of any protection or any warning sensations early led to recognized damage of the skin of the hands and faces of the investigators while in some patients the prolonged exposure time necessary for making skull plates resulted in alopecia. The discovery of this epiling effect led Freund to treat a disfiguring hairy nevus in a young girl. He reported his results in January, 1897, and widespread use of x rays in the therapy of skin diseases followed.

At the time of the discovery of x-rays the essential equipment—Ruhmkorff or Tesla coils or a static machine and Crookes tubes—was already at hand in every well established laboratory of physics (Figs. 1 and 2) and hence the necessary parts were quickly available to physicians but dosage for a given procedure was unknown and there were no instruments to record the physical factors used. The intensity of the current and the penetrating quality of the rays were estimated by holding the hand in front of the fluoroscope dosage was estimated by biological effect—erythema or epilation. Ammeter milliamperemeter and spinthrometer were however, developed relatively soon and the intensity of radiation and dosage began to be estimated by photographic effect or the darkening of barium platinocyanide dices. The small volume of current produced in early apparatus necessitated tremendous exposure times, so that the tubes quickly became overheated and the rays softer. The development of the interrupterless coil by Snook in 1905 leading to great increase in volume of the current produced the modifications of the Crookes (gas) tube together with accessory radiator and

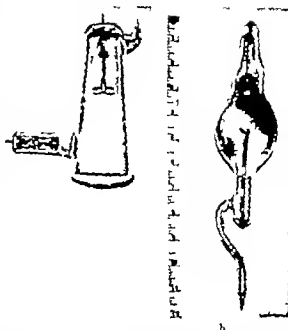


Fig. 2. a. Crookes tube, reproduced by H. C. Remickler. Westinghouse Electric & Manufacturing Co. from designs furnished by M. Ischeller to represent the type of tube used by Roentgen in his discovery of the rays. Observe that the target was the bottom of the glass tube. b. One of the tubes used in the Medical-Chirurgical College laboratory by M. K. Kamahian. This tube, made in 1897, has a cup-shaped cathode and an iridium-platinum target. The size of these tubes is indicated by the tape measure (in inches). It will be observed that the bulb of the tube shown in B is not more than 3 inches in diameter.

water cooling devices, and finally the development of the hot cathode high vacuum tube by Coolidge in 1913 overcame many of these early difficulties. These advances made possible sufficient constancy in volume and quality of the rays to enable radiologists to duplicate diagnostic and therapeutic results in different patients. It was years however before the ionization effects produced by the x-rays first reported by Roentgen in March 1896, led to the development of practical instruments for their measurement and the establishment of the unit of dose the roentgen in terms of that ionization (1928).

Early therapeutic radiation was unfiltered. For the depth dose measurements in 1904 showing that the intensity of the x rays diminishes rapidly from the surface to the depth of the body treated and that this decrease in intensity is much less if an absorbing layer such as 1 mm. of aluminum is placed on the surface led to the use of filters in Europe. When higher voltage equipment became available with the production of a greater proportion of shorter rays filtration was increased both as to thickness and density of the metal chosen.

As it became possible to produce x-rays of varying qualities knowledge of the type of ray best suited to

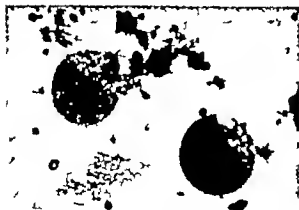


Fig. 1. The first shadowgraph, made accidentally by Prof. A. W. Goodspeed of the University of Pennsylvania while working with the rays from Crookes tubes in February 1896.

the condition to be treated had to be sought and the technique of application worked out. It became generally accepted for example, that in the treatment of ringworm of the scalp the epilation dose should be given accurately at a single sitting even though a large area is covered but in most inflammations and malignant neoplasms the full dose should be divided that for acute inflammations the dosage should be very small and given at short intervals and for chronic inflammations larger doses and longer intervals are indicated. Bergonie and Tribondeau had found in 1903 that immature cells and cells in an active stage of division were more sensitive than those which had already acquired the stressed or resting stage and 10 years later Regaud stressed the importance in the treatment of malignancies of fractional doses of comparatively low intensity extending over a long period since more neoplastic cells would thereby be exposed to irradiation during phases of mitosis. Coutard used these principles when, about 1920 he modified the treatment of malignant tumors especially of the oropharynx and larynx to obtain a high total dose with increased destructive effect on the tumor cells but with relatively less damage to the overlying normal tissue than had been possible with some of the previous methods. Recent development of supervoltage equipment has presented further problems in dosage.

LIZIAN DONALDSON, M.D.

Foulcra, B. R.: Investigation Into the Time Factor in the Roentgen Irradiation of Cancer Cells. *Acta rad. Stockholm*, 1945 26 463

A round cell sarcoma and a certain type of mouse carcinoma were irradiated by x rays of varying intensities over varied periods of time and the result was compared.

The tumor tissue was transplanted to a homologous strain of mice before irradiation. All of the mice then received irradiation of the whole body. After a period of not more than 24 hours after completion of the exposure (depending on the experimental group) the tumors were removed from the mice. The tumor tissues of all mice of the same experimental group were then mixed by mincing in order to minimize the individual variations. This tissue mixture was transplanted into a number of healthy mice and the effect of irradiation was then assessed.

(1) By the take percentage i.e. the percentage of animals in which the tumor grew after transplantation and irradiation.

(2) By the mean latent period i.e. the number of days after which 50 per cent of the takes became apparent as palpable tumors. (The normal values for nonirradiated tumor tissue are 5 days for sarcoma and 6 or 7 days for carcinoma.)

Four intensities of radiation were used 58 r/min, 33 r/min, 3.3 r/min and 1 r/min. The delivered dose was the same in all of the cases i.e. 1,600 r to mice with sarcoma and 1,600 r to the mice with carcinoma. A middle dose was delivered by a single

exposure of the mice to continuous radiation of constant intensity which varied only with the experiment. This necessitated exposure times ranging from 20 to 1,600 minutes.

The principal findings were as follows:
1. Round cell sarcoma. The take percentage dropped 25 per cent and the mean latent period rose from 15 to 18 days when the intensity was lowered from 58 r/min to 1 r/min. The main change was observed at the lowest intensity which is therefore considered a critical intensity. This tumor is thus more sensitive to low intensity radiation. The most effective intensity has not been reached in the experiment but can be assumed to lie below the critical intensity of 1 r/min.

2. Krebs No. 2 mouse carcinoma. A drop of the intensity causes a proportionate rise of the percentage takes (up to 20%) and a reduction of the mean latent period from 17 to 13 days. This indicates that protraction reduces the effectiveness of radiation on this type of tumor. No critical intensity was observed with this tumor.

A number of histological examinations of both tumors was performed after exposure to staggered doses of x rays (in steps of 500 r) in order to study the relation of the cell life cycle to radiosensitivity. Within the studied range only the sarcoma displayed a cyclic response, to irradiation. Mitosis of the sarcoma cells was increased after a certain low dose of x rays was delivered to the specimen.

The author arrives at the following conclusions:
Within the studied range the carcinoma becomes more radioresistant with increasing protraction, probably because the cumulative effect of radiation is more than counteracted by the recovery which takes place during the low intensity irradiation.

The sarcoma becomes more sensitive to radiation with increasing protraction because of the increased probability that the cells are affected during the sensitive phase of their cycle. This cycle may be intrinsic (the sensitive phase being the stage of premittosis) or induced by the physicochemical action of the x rays.

GERHART S. SCHWARTZ, M.D.

MISCELLANEOUS

Timmes, J. J.: Radiation Sickness in Nagasaki. Preliminary Report. *U.S. War Med. Bull.* 1946 46 219

The author in this preliminary report presents his observations made in Nagasaki on the radiation effects resulting from the explosion of the atomic bomb. The study was begun 33 days after the initial blast. It was conducted at an improvised hospital established at the Chinkoen Primary School a fact which explains the many difficulties encountered.

In the beginning an average of 20 new cases were admitted to the hospital daily but within 2 weeks this number dropped to 1 or 2 new cases daily. The

Investigation was abruptly terminated on September 25, 1945 but some follow-up reports were secured later and they were sent to S. L. Warren and Shields Warren in charge of the Army and Navy scientific atomic bomb commissions, respectively.

The explosion of the atomic bomb is associated with a sudden excessive release of pressure, heat, and radiation. The effects of the pressure and heat on human beings differ in no way from those of the ordinary bomb but the release of radiant energy is something new.

The first concern was the possible remaining radioactivity on the ground and in the victims. The bomb was exploded at an estimated altitude of 800 feet with the aim to expend as much as possible of the radiant energy into the atmosphere. The author buried x-ray films in the bombed area, attached others to various objects about the so-called crater (a true crater does not exist). They all remained negative. Later investigators with the aid of the Geiger counter, likewise found the area safe as this extremely sensitive instrument registers only negligible amounts of radiation. The effect on the victims was studied by attaching x-ray films to their limbs for 18 hours. These too remained negative.

Another point of interest was the radiation sickness. The Japanese claimed that most of the deaths occurring during the first week after the blast were the result of this illness. However, they did not differentiate between blast victims and radiation victims and attributed many of the thermal burns to radiation burns. It is the author's impression that a large percentage of the early victims indeed died of the radiation effect. This is explained by the fact that most of the civilians were not in air raid shelters when the bomb was dropped. Concrete walls of 2 feet thickness probably would have afforded adequate protection.

A study of the patients themselves reveals some interesting data. All victims observed had been within 3 kilometers of the center of explosion.

There were only a few x-ray skin burns and they were mild in character. However, many cases of alopecia were seen. In some the hair started to fall out 1 to 3 days after the explosion, in others about the third week. At the end of a month a few of the patients had already begun to grow new hair of a downy nature. In none of the cases was the loss of hair complete.

The most important effect of the radiation was on the bone marrow. The majority of the cases exhibited an aplastic type of anemia. A white blood cell count under 1,000 indicated a poor prognosis although 1 patient with a 400 count recovered. In some instances the blood cells completely disappeared before death. Petechiae, gross hemorrhages, increased bleeding times (often above 45 minutes), thrombocytopenia, and urine revealing the presence of nephritis were noted frequently.

The average newly admitted patient complained of fever, malaise, loss of appetite, bleeding gingivae and hemorrhagic diarrhea. Oral changes constituted common occurrences. The tongue was of a smooth glossy appearance and the mucosal membranes showed changes varying from a simple inflammatory lesion to deep necrosis. The teeth were generally loose and easily removed by hand. Two cases of necrosis of the mandible and 1 of the maxilla were seen. Terminal infection, particularly bronchopneumonia, was found to be the most frequent immediate cause of death.

The prognosis was difficult to evaluate. Youth and a progressive rise in the white blood cell count represented good signs.

Therapeutic opportunities were limited.

T. LITTLE, M.D.

MISCELLANEOUS

CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Emerson, C. P., Jr. and Ebert R. V.: A Study of Shock in Battle Casualties. *Ann Surg* 1945 122 745

One hundred and twelve battle casualties admitted to a field hospital with serious abdominal chest, or extremity wounds have been studied by the authors. Fifty per cent of these patients were in severe shock. Detailed clinical observations were made in all cases as well as serial determinations of either the hemoglobin concentration or hematocrit reading. Measurements of the plasma volume and plasma protein concentration as well as hematocrit readings were completed in 57 cases in 33 cases multiple blood volume determinations were made either in the course of transfusion therapy or before and after operation.

The arterial blood pressure was found to provide the most reliable clinical index of blood volume deficiency. All patients with initial systolic pressures below 85 mm. of mercury excluding those with spinal cord transection were found to have marked oligemia, the deficit averaging 40 per cent of the expected normal blood volume all patients with this degree of hypotension had a diminution in blood volume that exceeded 25 per cent.

Blood volume and plasma protein measurements indicated that some degree of spontaneous hemodilution with low protein fluid often occurred in patients suffering from oligemic shock the amount of this dilution, however, was small rarely exceeding 300 c.c. It is concluded that a normal hematocrit reading or the demonstration of a mild anemia with a few hours after injury is no indication that a severe blood loss has not occurred. Severe anemia was produced by the administration of plasma to patients with marked oligemia.

The majority of patients presented no evidence of an excessive loss of plasma in proportion to the red cells in a few with severe abdominal wounds there was demonstrated a disproportionate plasma loss which resulted in a mild degree of erythroconcentration. The average total blood loss estimated to have occurred in cases of severe shock before admission to the hospital was 63 per cent. Hemorrhage appeared to have been most severe in patients with wounds of the extremities and least severe in patients with uncomplicated chest wounds.

Blood volume measurements were performed preoperatively and postoperatively in 10 cases in order to ascertain the degree of blood loss occurring in the course of various surgical procedures. The average loss in 3 patients subjected to open thoracotomy was 600 c.c. 5 patients requiring extensive abdominal surgery had an average of approximately 2 200 c.c.

Serial determinations of the blood volume indicated that hemorrhage occurred during the course of transfusion therapy in 11 of 23 patients studied. This complication was encountered most commonly in patients with severe wounds of the extremities, a majority of these patients suffering a loss which averaged 40 per cent of the blood and plasma transfused.

Plasma protein measurements before and after the injection of blood diluted with equal volumes of preservative solution indicate that retention of the latter in the blood stream is transient and not enough to produce significant hemodilution.

The mortality incidence of all patients admitted in severe shock was 32 per cent. of those whose arterial pressure on admission exceeded 85 mm. of mercury 11 per cent died within a similar period which included the first postoperative day. The majority of deaths were due to penetrating abdominal wounds. Cases are described in which the clinical signs of shock were unrelieved by therapy despite complete restoration of the blood volume to normal. The factors operative in the production of irreversible shock included severe infection lesions in due to pulmonary damage and long persisting combinations of anemia oligemia and hypotension with terminal signs of myocardial insufficiency.

Therapeutic indications for the use of whole blood and plasma are cited, and criteria for evaluating the requisite amount of transfusion therapy are discussed.

JOSEPH GASTER, M.D.

Brun, C. Knudsen, E. O. E., and Rasmussen F.: Post-syncopal Oliguria. Kidney Function and Circulatory Collapse. The Cause of Post-syncopal Oliguria. *Acta med scand* 1945 122 381 486

In the passive erect posture with a tilting board unintentional circulatory collapse occurs frequently. This is immediately followed by reduced diuresis which the authors call post-syncopal oliguria. This article deals with the investigation of renal function during post-syncopal oliguria and the cause of the latter.

Sixteen tilting experiments were done all of which were complicated by circulatory collapse. The oliguria lasted from 15 to about 90 minutes after the syncope the duration apparently being proportional to the fall in blood pressure. The diuresis always dropped to values of from 3 to 1 ml/min. and the specific gravity of the urine rose to about 1.030 or 1.035. The inulin concentration index during oliguria rose to about 120 from the normal of about 12 and the inulin clearance (glomerular filtration) was reduced slightly or excessively. In the latter instance when diuresis was resumed there followed briefly an increase to unexpectedly high values. The urea clearance was reduced in the period

Immediately after syncope and then followed by normal values. Fluctuations occurred as in the case of inulin and diodrast clearances but they were not nearly so pronounced presumably as a result of the increased return of urea in the tubuli during the oliguria.

Since plasma is cleansed completely or nearly so of diodrast by a single passage through the kidneys diodrast clearance was taken as a measure of the quantity of the renal plasma flow. Diodrast is excreted mainly in the renal tubules and only to a smaller extent by filtration in the glomeruli.

Diodrast clearance often was reduced slightly just after syncope and then returned to the initial value. However if the drop was great, there followed a marked temporary rise before the fall to normal. The filtration fraction was without significant change during the period of oliguria. Hemocoagulation occurred during syncope but after the individual had been put back to the horizontal posture there was a gradual dilution of the blood to a temporary lower than normal level toward the termination of the study. The blood pressure and pulse rate remained unaffected.

In the discussion emphasis is placed on the chance for error (savage phenomenon) in the clearance determinations which were then corrected and properly evaluated. Thus, the glomerular filtration and renal plasma flow are found to be normal during the period of oliguria.

These findings, together with the high concentration index for inulin and the high specific gravity for urine point to a greatly increased reabsorption of water in the renal tubules rather than to a decreased glomerular filtration as the mechanism which governs oliguria.

The authors then postulate that postsyncope oliguria is induced by a suddenly increased supply of antidiuretic hormone from the posterior lobe of the pituitary gland, reflexly stimulated by either the cerebral anoxia or by the effect on the pressoreceptors which is caused by the fall of the blood pressure.

Having postulated previously that an antidiuretic hormone from the posterior lobe of the pituitary gland was responsible for the greatly increased reabsorption of water in the renal tubuli which produced a postsyncope oliguria the authors endeavored to demonstrate the occurrence of this hormone.

First they tried to show that the effect on the diuresis is of a humoral nature by transfusing blood from newly collapsed subject. Three of the recipients sustained a diuresis fall comparable in severity and duration to the amount of blood transfused. In a out of 5 control experiment there was no change. The other recipient experienced a diuresis fall which was thought to be due to reflex action on the pituitary gland from repeated painful punctures during the venesection.

Since the posterior lobe hormone of the pituitary gland is proved to regulate the secretion of chloride in the kidney the chloride output in the urine was determined after collapse and after oliguria trans-

mitted by transfusion. The findings were identical with those observed after the ingestion of inulin, an antidiuretic extract of the posterior pituitary lobe. The minute chloride output did not increase but the chloride concentration index fell below 1 while the plasma concentration decreased and the chloride in the urine increased markedly.

Finally, studies were made on 2 patients suffering from diabetes insipidus. These patients are assumed to have a reduced production of antidiuretic hormone. The postsyncope oliguria was a marked one in normal people but of much shorter duration. The urine chloride concentration rose to considerably below the plasma chloride concentration. The same conditions prevailed after an inosipidin injection. The short period of oliguria would tend to point to an inability on the part of a patient with diabetes insipidus to produce antidiuretic pituitary hormone.

These three series of studies taken together suggest that postsyncope oliguria is conditioned by the pituitary gland. The authors are quick to point out that this type of oliguria is probably merely an accompanying phenomenon to another pituitary regulation, first and foremost being a regulation of the tone of the capillaries. The oliguria often seen clinically in circulatory insufficiency viz., in shock states from burns, anesthesia, and hemorrhage is designated as collapse oliguria in contrast to postsyncope oliguria, during which period the blood pressure is normal.

DANIEL H. LYNN, M.D.

Imperati L.: Malaria in the Practice of Surgery.

The Inter Relationships between Malarial Infections and Surgical Diseases (La malaria in chirurgia. Rapporti fra infezione malarica e malattie chirurgiche) *Gior Ital chir* 1915, 11:15.

The author was a captain in the medical branch of the Italian military forces in Sardinia stationed at first at the principal military hospital at Cagliari and later transferred to Iglesias. During this time he witnessed the disquieting recrudescence of malaria in that country and gained the experience which he details in part in a series of articles of which the first is covered by this abstract. A second article will be concerned with the problem of surgery in the patient with malarial splenomegaly, and a third will treat of surgery in the malarial patient.

After a relatively brief discussion of his subject—including the pathogenicity of the plasmodium at different places and times, and in relation to the varying resistance of the patient, the effect of chronic malaria on the reticuloendothelial system and the melanocytocytic foci of Henry—the author turns to the details of his own personal views and experiences. This discussion is again divided into subsections: the first concerning the malarial recurrences appearing as a result of surgical injuries and the second concerning the surgical syndromes occurring as manifestations of malarial infection.

In deciding on the complicity of the malarial plasmodium in the febrile condition of the patient

the author and his coworkers have depended as often on the leucopenia with the relative mononucleosis of malaria as on the actual finding of the parasite in the blood cells and malaria has been suspected even in continuous fevers since recurrent malaria is capable of producing a remittent continuous temperature. The author remembers one instance of a thoracotomized pleural empyema in which after a short favorable course a fever of a remittent continuous type suddenly developed. Intense and prolonged treatment with quinine produced a fall in the temperature, although no blood parasites were ever found.

The second part of this article discusses the cases in which the malaria itself produced surgical syndromes resembling those of appendicitis, cholecystitis or gastric or duodenal ulcer. Certain elements of the true surgical picture (vomiting, constipation, facies peritoneal and/or defense musculaire) were usually missing entirely and most of the other cases would not have deceived a physician experienced in the vagaries of malaria. However the author cites some dozen cases pronounced cholecystitis (3 cases) or appendicitis by the medical department and referred to surgery in all of which but 2 the malarial nature of the dolor abdominalis was recognized satisfactorily and in time. Perhaps the case history disclosed malarial antecedence or perhaps the abdominal wall was not sufficiently spastic for a defense musculaire and out of proportion to a seeming amount of pain present in any event quinine satisfactorily cured all but 2 of these cases only in 2 instances was laboratory help indispensable. The first instance was that of an artilleryman, who had been in Sardinia for 3 years. This patient had sudden violent attacks of abdominal pain, localizing to the right iliac fossa, which were accompanied by retention of feces and partially of gas, and some display of a neurotic disposition (weeping). Physical examination the following day disclosed facies aniosa, a temperature of 39 C, rhythmic, thrready pulse of 120 and a dry tongue; the abdomen was uniformly spastic, retracted almost still (borborygmi) and presented diffuse cutaneous hyperaesthesia. However the abdominal spasm was not a true defense musculaire as it was more or less equal in intensity on the two sides and could be largely influenced by distracting the patient's attention also. In addition, the patient did not look sick enough for the presence of a phlogistic process. Blood examination disclosed the plasmodium praecox in great quantity. Quinine did not control the fever until the second day and even then the other symptoms persisted some abdominal pain remaining for many days.

The second patient was an aviator, first class, who after 3 years in Sardinia suddenly developed intra costal pain, irradiating posteriorly and fever of 39.5 C. Quinine injections on this same day were unsuccessful and the patient was referred to surgery

under the diagnosis of acute cholecystitis. However the impression was rather that of an atopic, subhepatic appendicitis and the author was invited to examine the patient. The abdomen was found to be tensely spastic throughout and painful to palpation; the temperature was 39 C with some morning remission; the tongue was dry in the gall bladder region; the pain was more intense and there was some muscular defense at this point; neither the liver nor spleen was palpable. The topography and season suggested malaria, even though no parasites were determinable at blood examination; however there were only 4,000 white cells with 10 per cent monocytes and a few hemohistoblastocytes. Quinine therapy was again instituted and after 3 days the fever and pains had entirely disappeared. Here again the relatively good general condition of the patient throughout argued against a septic inflammatory process.

The author seems not to have encountered the phlogistic, even necrotic, processes at times ascribed by other authors to malaria itself such as the strumitis suppuratis of malarial origin of Ceballos and Gomez; malarial peritonitis Demjanow's appendicitis of malaria, Caruso's appendicitis of necrotic and gangrenous type, or the perivisceritis parasitaria of Peperio and of Donati and he leaves open the question as to their authentically malarial character. However he does cite an instance of hemoptysis in which operation did not reveal the origin of the bleedings and which he therefore ascribed etiologyally to the malarial parasite. He passed over such causes as (tumor) small vascular thrombosis, and the production of punctate hemorrhages capable of producing fatty degeneration to the theory of so-called neurotrophism of the malarial virus wherein degenerative processes in the vegetative system give rise to vasomotor disturbances, a true angioneurosis. This theory was strengthened by the author's observation of a malarial (plasmodium praecox) asphyxia and parasthesia pallida bilateralis of the feet which cleared up on a regimen of quinine antispasmodics (atropin) and hot applications.

Among the involvements of the nervous system have also been those resembling an ascending polyneuritis even involvements of the cord such as monoplegias with loss of reflexes and amyotrophias of the author's patients, apparently as a sequela of malaria developed a rather persistent neuritis of the radial nerve with medicolegal implications. The observation of the author which seems to be unique in the literature, is that of a tertian malaria with concomitant tumescence of the testicle and epididymis without involvement of the endovaginal serosa or cord. The swelling and pain which was present disappeared gradually following cessation of the febrile attack, the detumescence being too rapid and complete for a pyogenic or other phlogistic process, and seemed due solely to the malarial infestation. In conclusion, however, the author warns against a too ready acceptance of what might be a surgical condition in a malarial patient as an exclusive malarial

rial condition and he cites 2 instances: one a ruptured appendix and the other an intestinal perforation in a patient with typhoid fever in which operative therapy was deferred because of prejudice toward a malarial etiology of the abdominal pains. The patient with the ruptured appendix recovered later following operation while the patient with typhoid fever did not. **JOHN W. BUDDECK M.D.**

Waalder E.: A Chromaffin Tumor Simulating Graves Disease. *Acta med sc d* 1945 23 1

Tumors arising from chromaffin tissue are very rare. About 100 cases have been described in the literature. Eighty of them had their source in the suprarenal glands, while the remainder arose from the paraganglia. Eighteen cases of extrasuprarenal chromaffin tumors have been reported in the literature. In several cases the tumors have given rise to characteristic clinical manifestations the patients being subject to attacks of headache a sense of pressure in the epigastrium palpitation of the heart excessive sweating coldness and pallor of the limbs and a high blood pressure. In the intervals between attacks the blood pressure would be normal and the patient would feel well. Belt and Powell have given this group of symptoms the title of the suprarenal sympathetic syndrome. The true nature of the disease has often been overlooked in these cases.

In account of a misinterpreted case with pheochromocytoma originating in the right celiac ganglion is presented. A man age 49 had been well until 3½ years ago when he developed a disease characterized by palpitation of the heart, excessive sweating and nervousness which required hospital care on several occasions. During his first hospital stay the basal metabolism was 145 per cent (pulse 8) and the blood pressure 176/112 there was enlargement of the heart, and albumin in the urine and the latter contained erythrocytes and hyaline and granular casts. During his stay in the hospital the blood pressure was 190/125 185/112 170/130 and 116/114 and the basal metabolism ranged from 156 to 120 per cent. A diagnosis of Graves disease and nephritis was made and following preoperative therapy a thyroidectomy was done. The surgeon was in doubt as to the diagnosis at the time of the operation and his histological examination of the excised gland showed no changes characteristic of Graves disease.

The attacks of palpitation of the heart and excessive sweating returned. During the second stay in

the hospital the blood pressure varied between 230/140 and 155/90 but no relationship between it and the patient's symptoms was noted. The basal metabolism on four occasions was 140, 130, 116 and 108 per cent. The diagnosis was still considered thyrotoxicosis with hypertension.

Upon his third stay he became worse and death occurred with signs of a subarachnoid hemorrhage. Postmortem examination revealed the pheochromocytoma in the right celiac ganglion, a brain hemorrhage arteriosclerosis and arteriolar sclerosis, and enlargement of the heart. Analysis showed that the tumor contained less adrenalin than the tumors in several other cases investigated by the much more exact biological examination.

It is of special interest in this case that it was interpreted as one of Graves disease. The diagnostic mistake is of interest for two reasons. In the first place Graves disease was suspected in some of the cases of chromaffin tumor published earlier. Furthermore Belt and Powell drew attention in 1934 to the similarity of the syndrome of certain cases recently described as "nonglitterous hyperthyroidism" to the suprarenal sympathetic syndrome. In the second place it is interesting that the basal metabolism was increased in this case not only because such an increase was misleading to the diagnosis, but also because it provided matter for thought concerning the cause for such an increase. According to Cohen in 1937 adrenalin increases the metabolism by stimulating the action of the sympathetic system. It has been found that patients with chromaffin tumors are sympathicotonic, and it is natural to assume that in these cases an increase of the basal metabolism depends on an increased production of adrenalin. Hitherto the manifestations observed of chromaffin tumors have included a rise of the blood pressure, tachycardia, excessive sweating coldness of the limbs glycosuria, and hyperglycemia. To these manifestations one may add an increase of the basal metabolism which will also be found. **JOHN E. KARANT M.D.**

CORRECTION

Attention is called to the abstract on page 41 of the May, 1946, issue of the *International Abstract of Surgery*. The heading of this abstract is incorrect and should read: **McCarthy M. D. Lewis, J. R., and Conner, J.: A Standardized Back Burn Procedure for the Effects of Therapeutic and Toxic Agents on Long Term Survival. *J Lab Clin M* 945 30 1027**

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